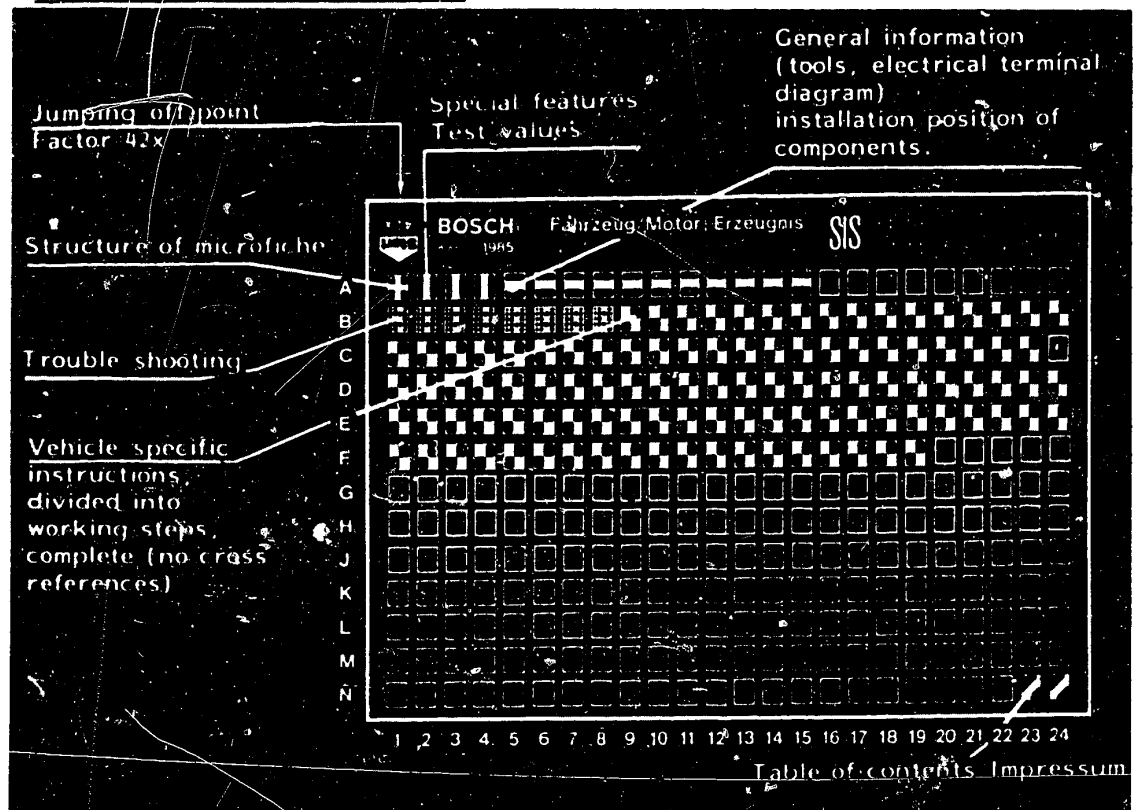


Structure of microfiche



1. Read from left to right
2. Title of microfiche (appears on each coordinate)

E16	Product/component/test step
	Vehicle/engine

Coordinate

3. Limits of section

Beginning	Mid-section	End	One-page section

4. Purely vehicle-specific passages in the text are marked with a vertical bar.

5. Reference to relevant working steps in the test specifications, e.g. coordinate C6.

C6

A1	Trouble-shooting program	
-----------	--------------------------	--

1. Special features

Turbo diesel engine = VE with external manifold-pressure compensator

2. Test specifications

2.1 Idle speed

C10

1.6l diesel and turbo diesel engine $820 \pm 50 \text{ min}^{-1}$

2.2 Nozzle-opening pressure:

C11

Diesel engine

Injection pressure of new nozzles 130 + 8 bar

Injection pressure of used nozzles 120 bar

Turbo diesel engine

Injection pressure of new nozzles 155 + 8 bar

Injection pressure of used nozzles 140 bar

2.3 Filter test

C18

max. allowable differential
pressure

0.3 bar

A2

Special features/test specifications

VW-Transporter



Test specifications (continued)

2.4 Compression pressure

D9

Specification	34 bar
Wear limit	28 bar
Allowable difference between cylinders	max. 5 bar

2.5 Compression loss:

max. 25%

D13

2.6 Injection timing:

F8

Engine position: Cyl. 1 at TDC

Checking value - diesel and turbo diesel

Pump position: 0.83...0.97 mm
ABDC

Setting value

Pump position: 0.90 ± 0.02 mm
ABDC

F13

2.7 Charge-air pressure: 0.64...0.76 bar

2.8 Blow-off valve pressure: 0.81 + 0.05 bar

A3

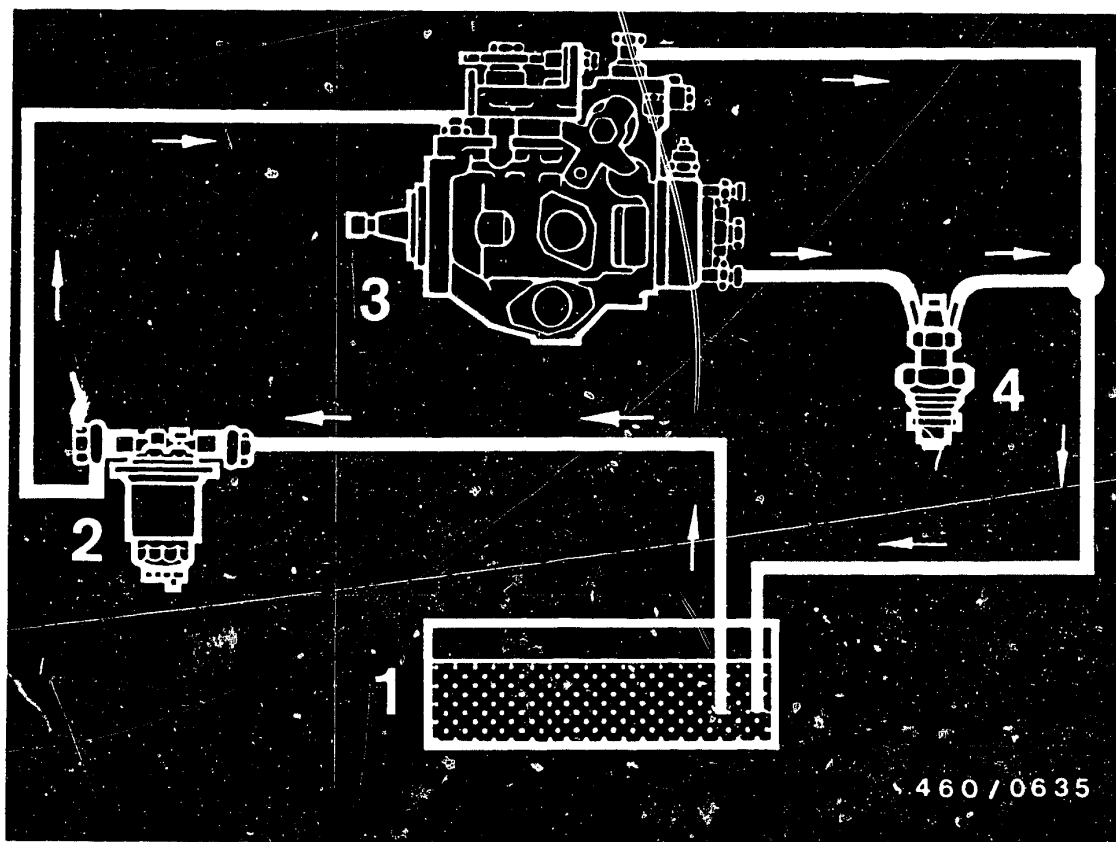
Test specifications
VW-Transporter



2.9 Torques

Injection pump sprocket	45 Nm
Injection pump mounting bolts	25 Nm
Fuel lines	25 Nm
Screw plug	15 Nm
Nozzle holder mounting bolts	70 Nm
Sheathed-element glow plugs	40 Nm
Camshaft sprocket	45 Nm
Support bracket on injection pump (Mounting bolt)	25 Nm
Turbocharger/exhaust manifold mounting bolts	45 Nm
Exhaust manifold/engine block	25 Nm
Exhaust pipe	25 Nm
Vent screw	15 Nm
Toothed-belt tensioning roller	45 Nm





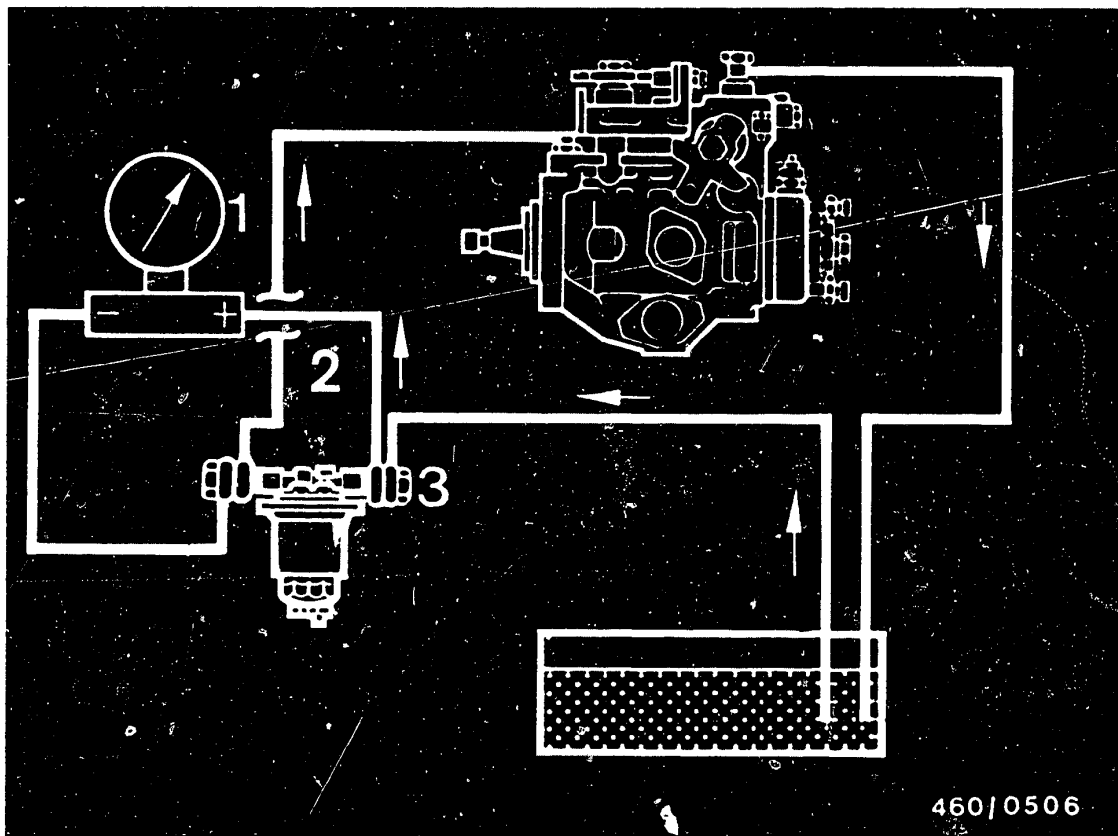
- 1 = Fuel tank
- 2 = Fuel filter
- 3 = Distributor-type injection pump
- 4 = Injection nozzles

3. Fuel line diagram

The fuel lines are connected according to the above diagram.

Fuel flows in the direction of the arrow.



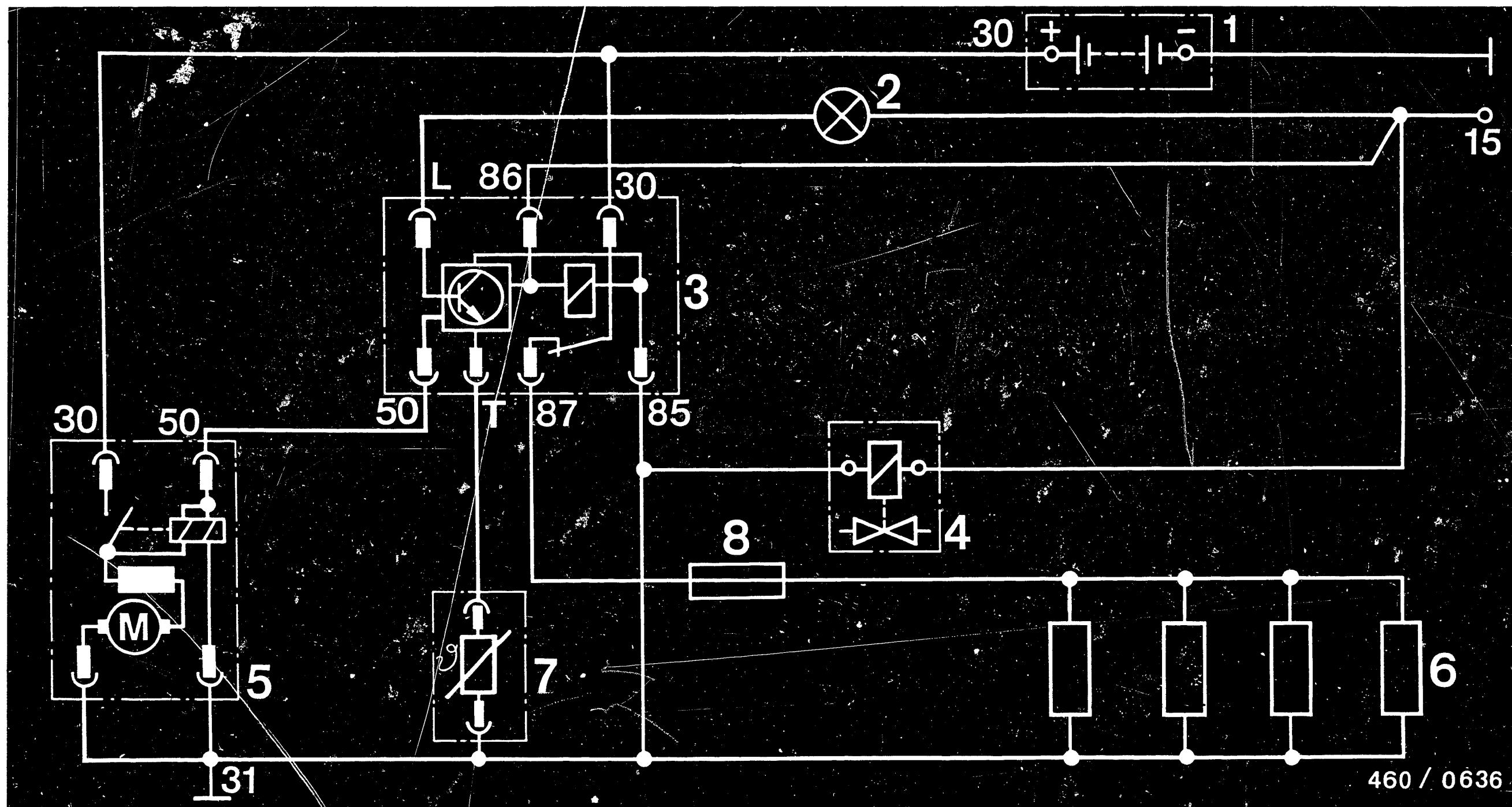


- 1 = Differential pressure gauge
- 2 = Filter discharge
(Use inlet union and
extra-long hollow bolt, 2 443 456 020)
- 3 = Filter inlet
(Use inlet union and
extra-long hollow bolt, 2 443 456 020)

3.1 Connection diagram for filter check

Connect differential pressure gauge to corresponding fittings on fuel filter.





460 / 0636

- | | | | |
|----------------------|--------------------------------|----------------|------------------------|
| 1 = Battery | 3 = Glow duration control unit | 5 = Starter | 7 = Temperature sensor |
| 2 = Visual indicator | 4 = Solenoid-operated valve | 6 = Glow plugs | 8 = 80 A fuse |

4. Wiring diagram for pre-heating system

A7

Wiring diagram for pre-heating system
VW-Transporter



A8

Wiring diagram for pre-heating system
VW-Transporter



5. Test instruments and tools

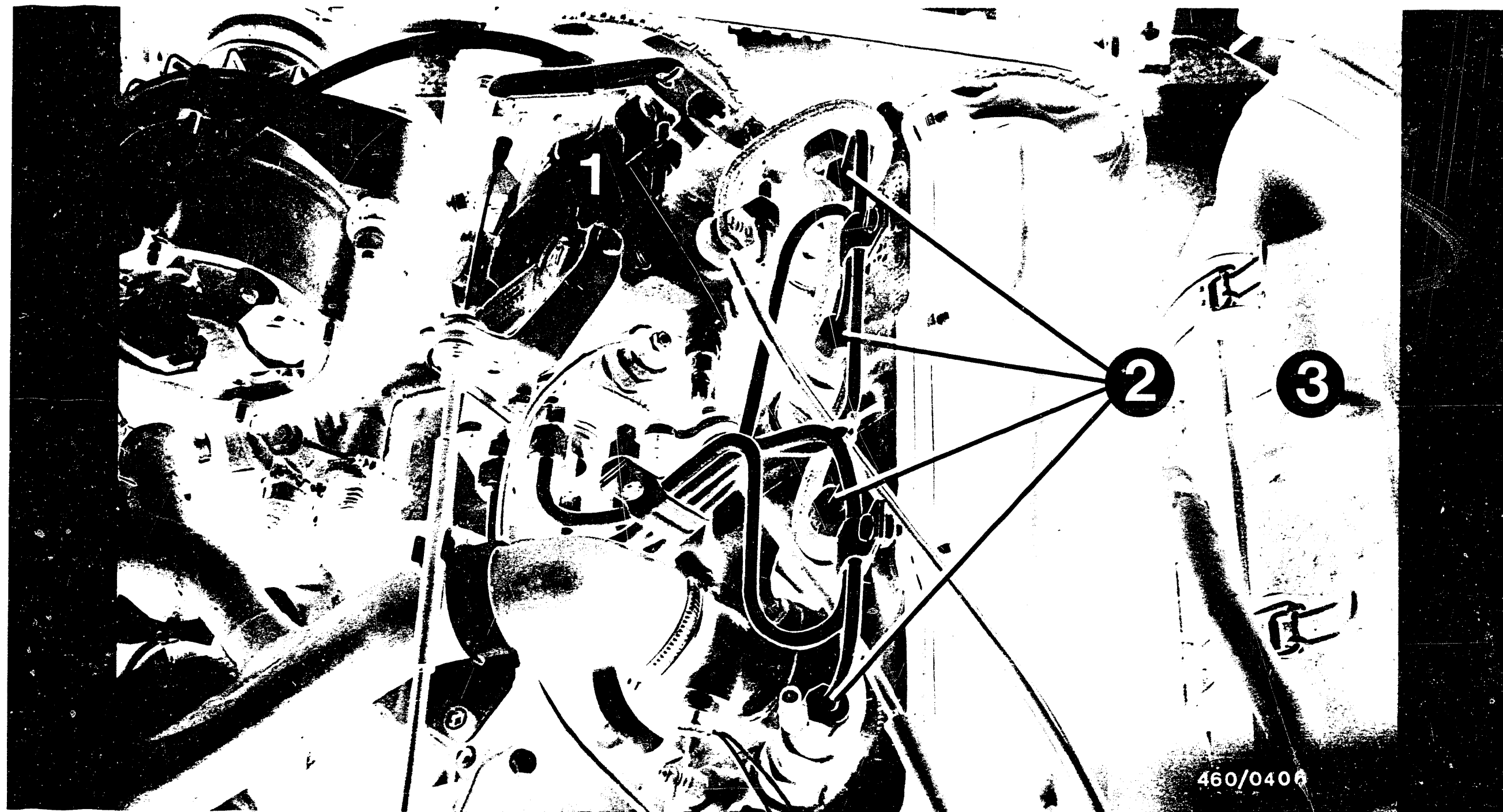
Description	Order number	Use
Gear puller	KDEP 1118	Pulling injection pump sprocket
Securing pin	KDEP 1122	Securing injection pump sprocket
Arm bracket	KDEP 1116	Locking camshaft sprocket
Toothed belt tension checker	KDEP 1121	Checking toothed belt tension
Setting straightedge	KDEP 1117	Locking camshaft
Box wrench	KDEP 1115	Loosening/tightening injection lines
Measuring tool	KDEP 1085	Pump/engine position agreement
Miniature dial indicator Graduation: 1/100 mm	commercially available, e.g. Hahn & Kolb 7000 Stuttgart Order No. 33003 with adapter KDEP 1127	Pump/engine position agreement
Pressure measuring tool or pressure gauge 0 ... 1.6 bar	KDJE-P 100 e.g. Wika No. 4184	Checking charging-air pressure



Test equipment and tools (continued)

Description	Part Number	Use
Nozzle tester	EFEP 60 H 0 681 200 502	Testing injection nozzles
Compression-loss tester	EFAW 210 A 0 681 001 901	Testing engine compression loss
Tachometer	commercially available e.g. Dr.E.Horn GmbH Meßgerätefabrik Postfach 40 7036 Schönaich Order Desig: HT 446 (with digital display)	Adjusting engine speed
Differential-pressure gauge	commercially available Part No. NG 160/311-911 -1.0+4.0 bar Haenni Nauheimer Str. 78-80 7000 Stuttgart 50	Filter test
Evaluation unit	0 684 102 050	Smoke test
Accessory box w. metering unit	0 681 169 038	
Compression tester	Commercially available	Testing engine compression
VA tester	ETT 011.00 0 684 101 100	Testing preheating system





1 = Fuel-injection pump

2 = Injection nozzles

3 = Air filter

6. Installation position of components - diesel (80 →)

A11

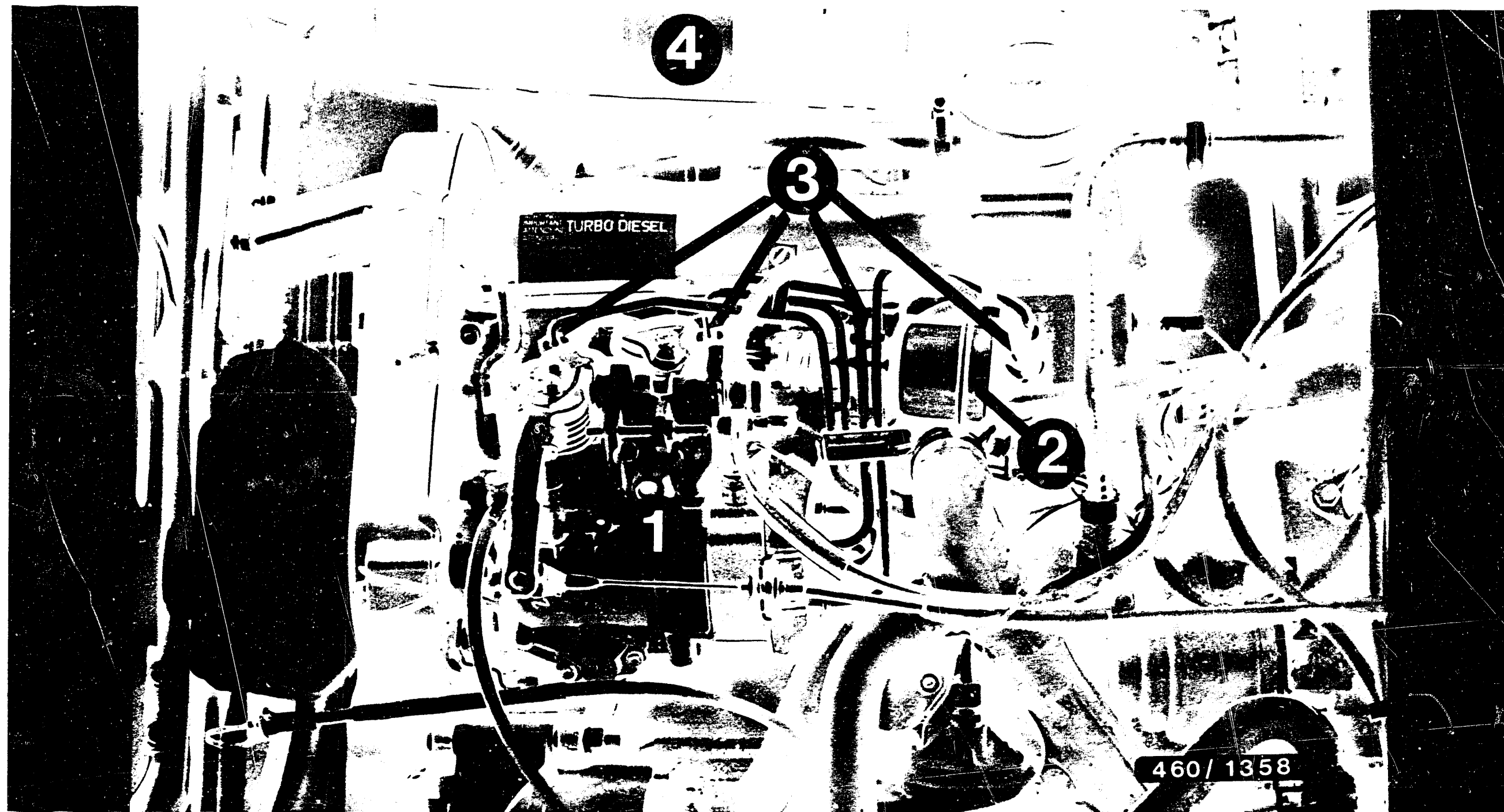
Installation position of components
VW-Transporter



A12

Installation position of components
VW-Transporter





1 = Fuel-injection pump

2 = External manifold-pressure
compensator

3 = Injection nozzles

4 = Air filter

6.1 Installation position of components - turbo diesel (01.85 →)

A13

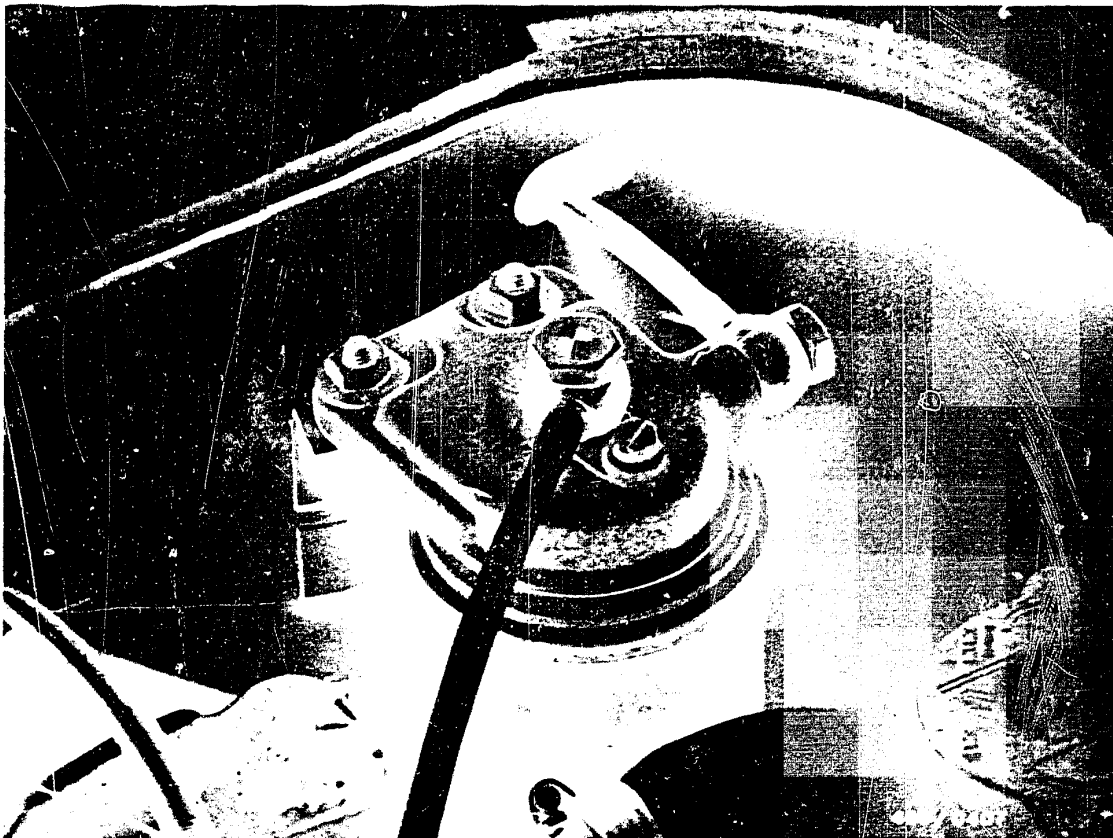
Installation position of components
VW-Transporter



A14

Installation position of components
VW-Transporter





6.2 Installation position of fuel filter

The fuel filter is in the engine compartment on the right-hand side as viewed in the forward direction of travel.



7. Trouble-shooting

Customer complaint (fault symptom)

1. Engine fails to start or starts only with great difficulty when warm							
2. Engine fails to start or starts only with great difficulty when cold							
3. Engine hunts at idle							
4. Rough idle when engine warm							
5. Engine missing during vehicle operation							
6. Unsatisfactory performance							
<u>Cause (component fault)</u>						<u>Coordinates</u>	
●	●			●	●	Tank empty; tank vent clogged	B 9
●	●			●	●	Injection lines clogged or constricted (check fuel lines)	C 1
	●		●			Injection sequence does not correspond to firing sequence (check routing of fuel-injection tubing)	B 11
				●		Overflow restriction clogged	B 12
●	●					Shutoff device defective	B 13
		●		●	●	Inlet-union screws of inlet and return lines clogged (see diagram of fuel lines)	B 16
●	●		●	●	●	Air in fuel system	B 18
	●					Heavy paraffin deposits in filter in winter operation (replace filter box)	B 20
●	●			●	●	Lines leaking or broken; connections loose	B 23
●	●			●	●	Supply lines clogged (check fuel lines)	C 1

B1

Trouble-shooting
VW-Transporter


B2

Trouble-shooting
VW-Transporter



Trouble-shooting (continued)

1. Engine fails to start or starts only with great difficulty when warm							
2. Engine fails to start or starts only with great difficulty when cold							
3. Engine hunts at idle							
4. Rough idle when engine warm							
5. Engine missing during vehicle operation							
6. Unsatisfactory performance							
<u>Cause</u> (component fault)						<u>Coordinates</u>	
					●	Engine air filter clogged	C 2
			●			Idle speed incorrect	C 10
●	●		●		●	Injection nozzle defective	C 11
	●		●		●	Timing of pump to engine incorrect	F 8
●	●			●	●	Fuel filter (differential-pressure test)	C 18
	●					Preheating system defective	C 21
					●	Timing device defective (remove injection pump)	D 8
	●		●			Engine compression poor or uneven	D 9
					●	Maximum engine speed incorrectly set (remove injection pump)	D 19
●	●	●	●	●	●	Injection pump (governor) defective or out of adjustment (remove injection pump)	D 19
					●	Check turbocharger for leaks and charge-air pressure	F 13

B3

Trouble-shooting
VW-Transporter



B4

Trouble-shooting
VW-Transporter



Trouble-shooting (continued)

7. Insufficient engine power in conjunction with high fuel consumption, possibly smoking								
8. Engine cannot be stopped								
9. Engine runs rough, in conjunction with black smoke at full load; possibly lack of power								
10. Fog-like smoke at full load (white)								
11. Incorrect engine speeds								
12. Engine will not rev up when cold								
13. Distributor-type fuel-injection pump overheating								
<u>Cause</u> (component fault)							<u>Coordinates</u>	
			●		●		Supply lines clogged (check fuel lines)	C 1
			●		●		Injection lines clogged or constricted (check fuel lines)	C 1
		●					Engine air filter clogged	C 9
				●			Idle speed incorrect	C 10
		●					Injection nozzle defective	C 11
●		●	●		●		Timing of pump to engine incorrect	F 8
			●		●		Fuel filter clogged (differential-pressure test)	C 18
		●	●				Timing device defective (remove injection pump)	D 8
●					●		Engine compression poor or uneven	D 9
				●			Maximum engine speed incorrectly set (remove injection pump)	D 19
●	●	●	●	●	●	●	Injection pump (governor) defective or out of adjustment (remove injection pump)	D 19

B5

Trouble-shooting
VW-Transporter



B6

Trouble-shooting
VW-Transporter



Trouble-shooting (continued)

7. Insufficient engine power in conjunction with high fuel consumption, possibly smoking							
8. Engine cannot be stopped							
9. Engine runs rough, in conjunction with black smoke at full load; possibly lack of power							
10. Fog-like smoke at full load (white)							
11. Incorrect engine speeds							
12. Engine will not rev up when cold							
13. Distributor-type fuel-injection pump overheating							
<u>Cause</u>							
<u>Coordinates</u>							
			●		●	Tank empty; tank vent clogged	B 9
●						Engine timing out of adjustment	E' 21
		●		●	●	Injection sequence does not correspond to firing sequence (check routing of fuel-injection tubing)	B 11
					●	Overflow restriction clogged	B 12
	●					Shutoff device defective	B 13
		●	●	●		Inlet-union screws of inlet and return lines clogged (see diagram of fuel lines)	B 16
		●		●		Air in fuel system	B 18
				●		Heavy paraffin deposits in filter in winter operation (replace filter box)	B 20
●						Lines leaking or broken; connections loose	B 23

B7

Trouble-shooting
VW-Transporter



B8

Trouble-shooting
VW-Transporter





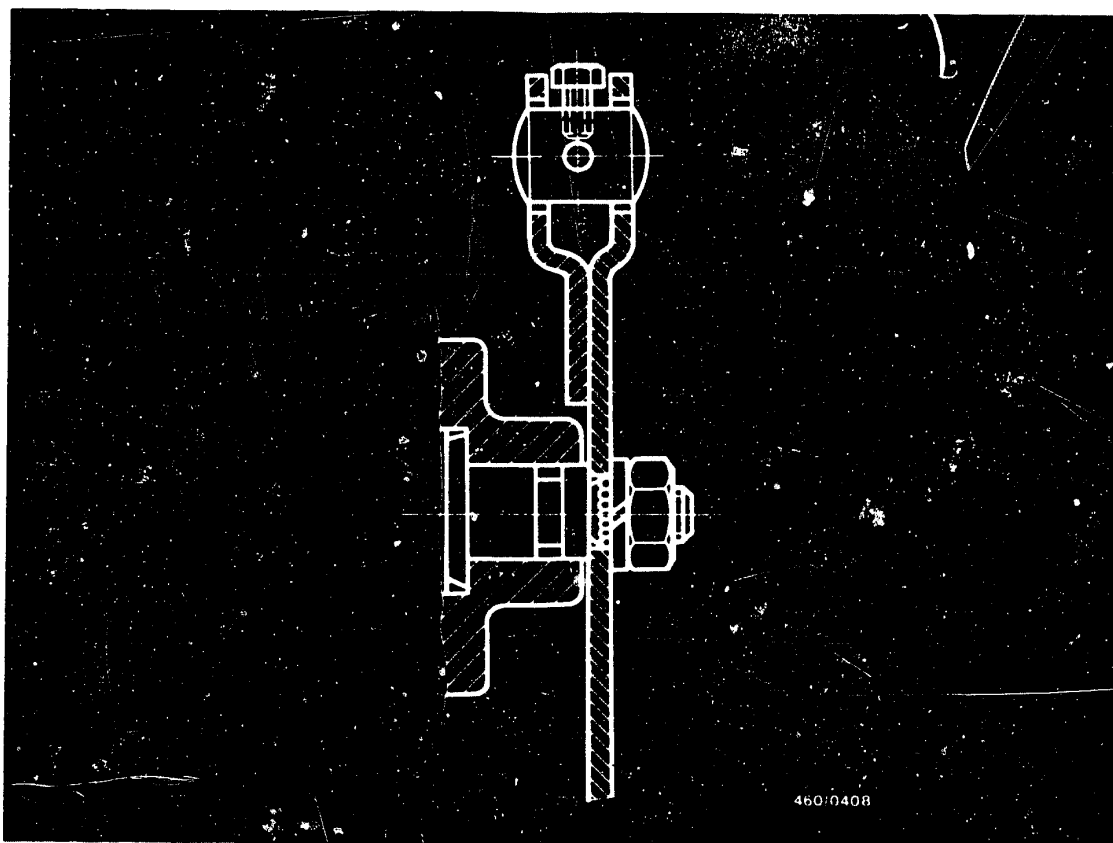
8. Checking tank ventilation

Remove fuel cap.

If this cures the problem, tank ventilation system is defective.

Remove tank vent lines and check for clogs or restrictions. Check filler neck on tank if necessary.



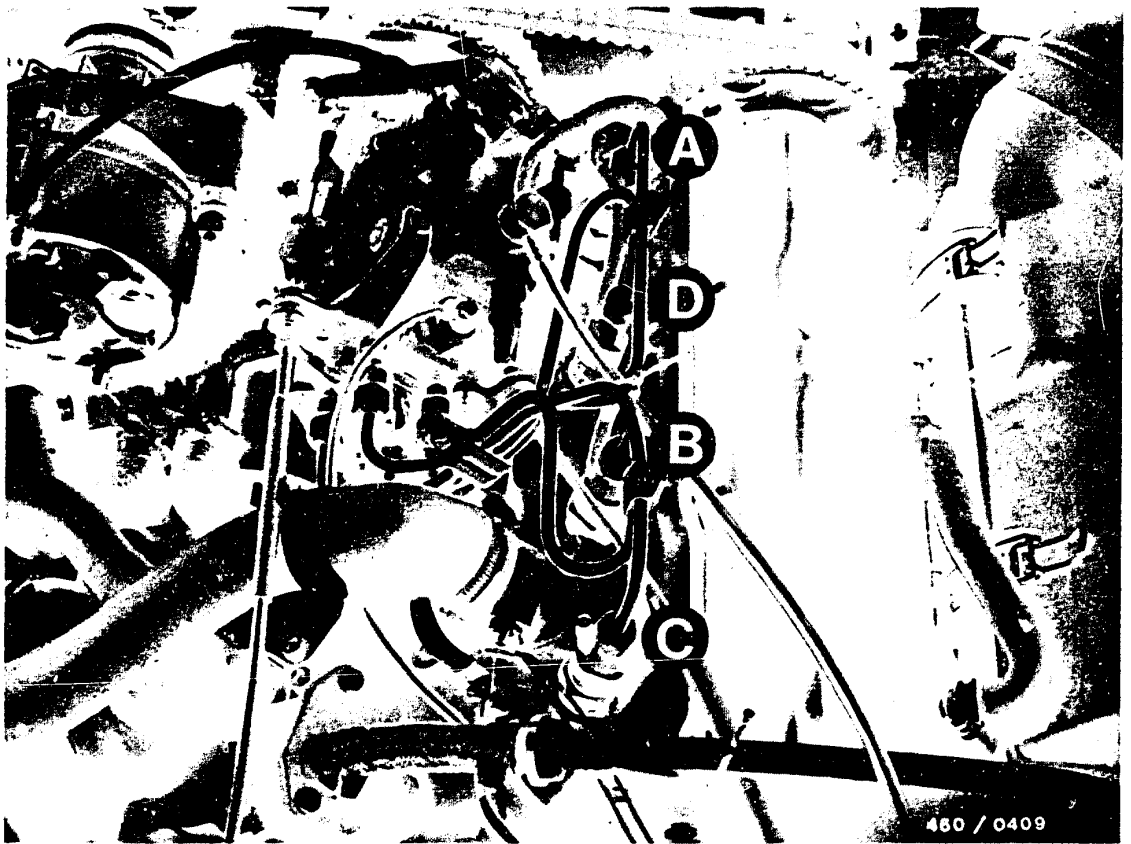


9. Check operation of cold-start accelerator (diesel)

Check whether the stop lever is in its initial position with cold-start accelerator disengaged.

With cold-start accelerator engaged, the stop lever must rest against the stop bracket.

If the stop lever remains in a different position, the injection pump must be removed.

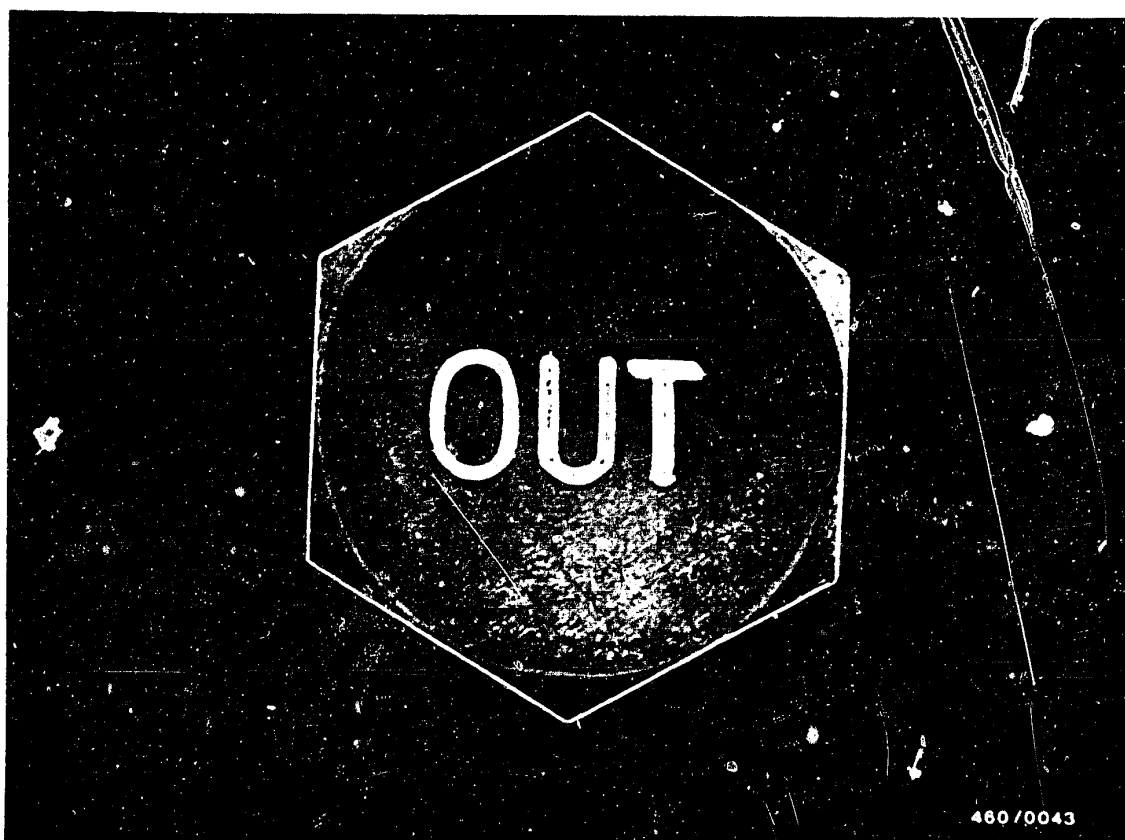


10. Checking routing of delivery lines

The delivery lines are connected to each other by hose clamps so that the outlet ends cannot be switched.

If the problem persists, check the routing of the lines as shown in the photo above.

The injection pump outlet configuration for the engine cylinders is indicated by the letters A - D.

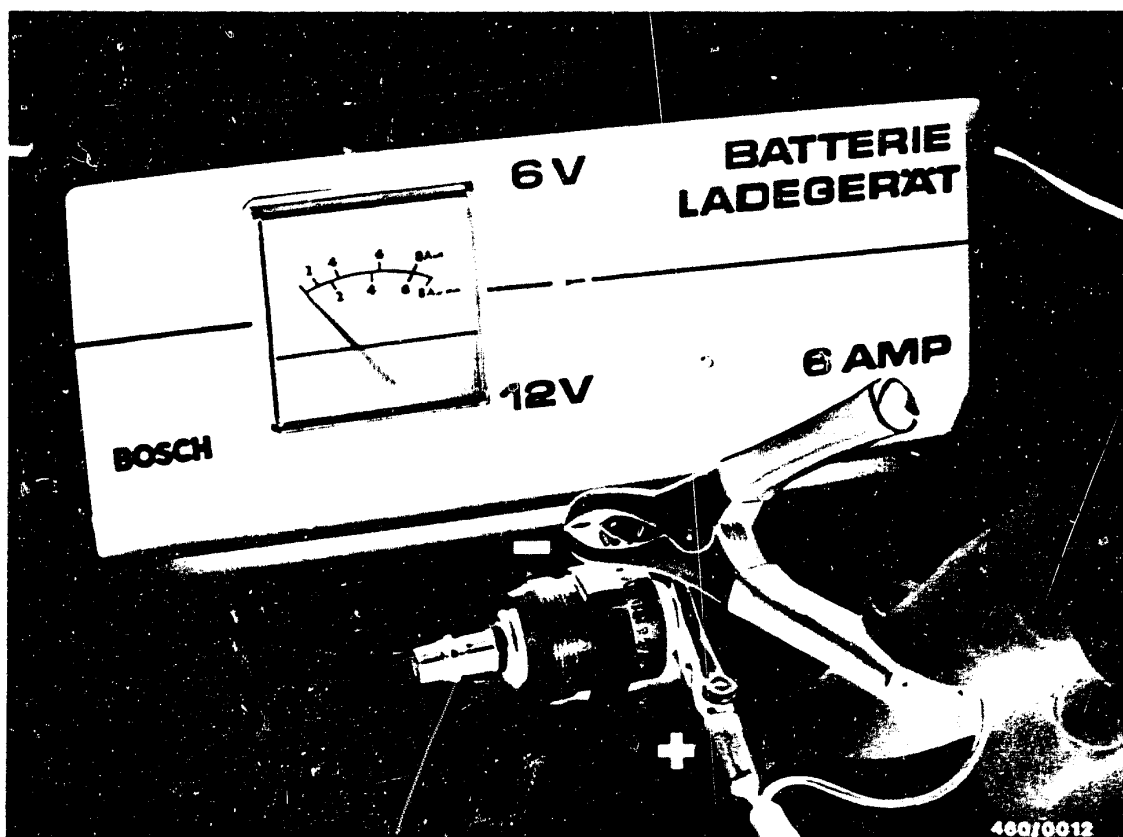


11. Checking overflow valve

Remove injection pump overflow valve (marked "OUT").

Visually inspect wire mesh screen for contamination

If problem persists, replace valve.



12. Checking operation of shutoff device

12.1 Engine does not start

Check for voltage (min. 10 V) across solenoid with glow plug and start switch on (drive position).

If voltage is good, disconnect injection lines and remove solenoid-operated valve

Make sure valve is c l e a n !

Check for proper operation of valve when removed.

Note:

As solenoid-operated valve is normally fuel-cooled, apply voltage only briefly.



12.2 Engine cannot be switched off

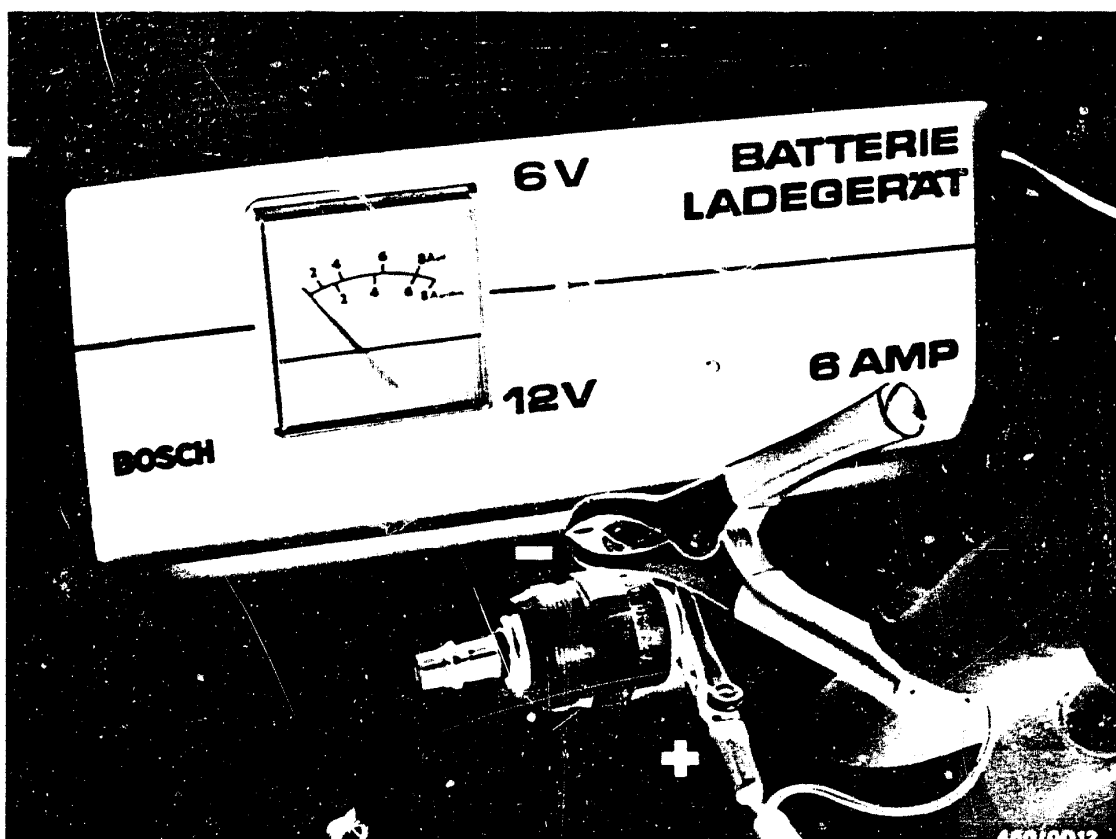
With glow-plug and starter switch in the stop position, there must be no voltage at the solenoid-operated valve, i.e. the fuel inlet to the distributor-pump plunger is interrupted.

If the engine continues to run although there is no voltage at the solenoid-operated valve, it is possible to switch off the engine as follows:

Select 3rd or 4th gear.

Jam on foot brake and let out clutch pedal.





12.2.1 Checking the solenoid-operated valve

Remove injection lines.

Remove solenoid-operated valve.

Ensure utmost cleanliness.

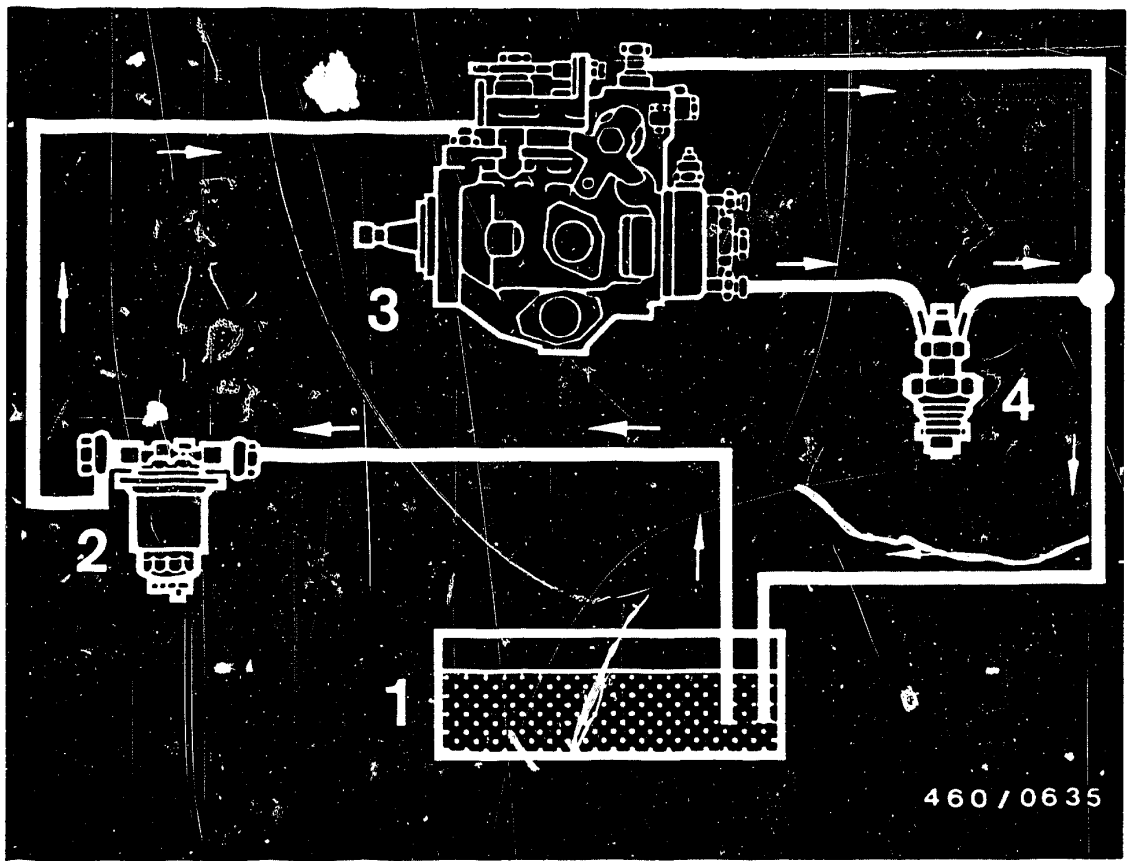
Check operation of solenoid-operated valve while removed.

Note:

When removed, the solenoid-operated valve must be supplied with voltage only briefly since it is no longer being cooled by the fuel.

Check valve seat in hydraulic head (visual examination).





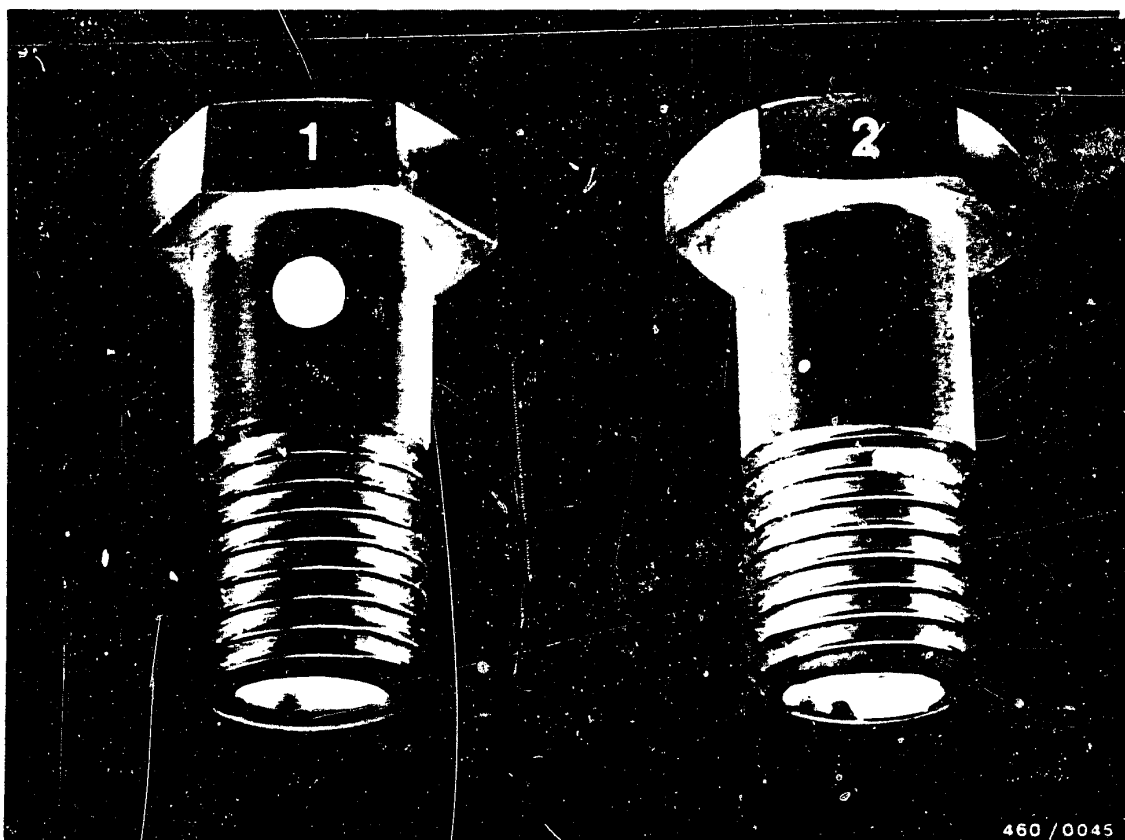
- 1 = Fuel tank
- 2 = Fuel filter
- 3 = Distributor-type injection pump
- 4 = Nozzles

13. Diagram of fuel lines

The fuel lines are connected as shown in the diagram.

Fuel flows in the direction of the arrow.





1 = Inlet-union screw for
fuel inlet

2 = Throttle screw for fuel
return

As regards the connections of the injection pump, make sure that the inlet-union screw for the fuel inlet and the throttle screw for the fuel return are not mixed up.

The throttle screw is on the cover of the injection pump and the head of the screw is marked "out".





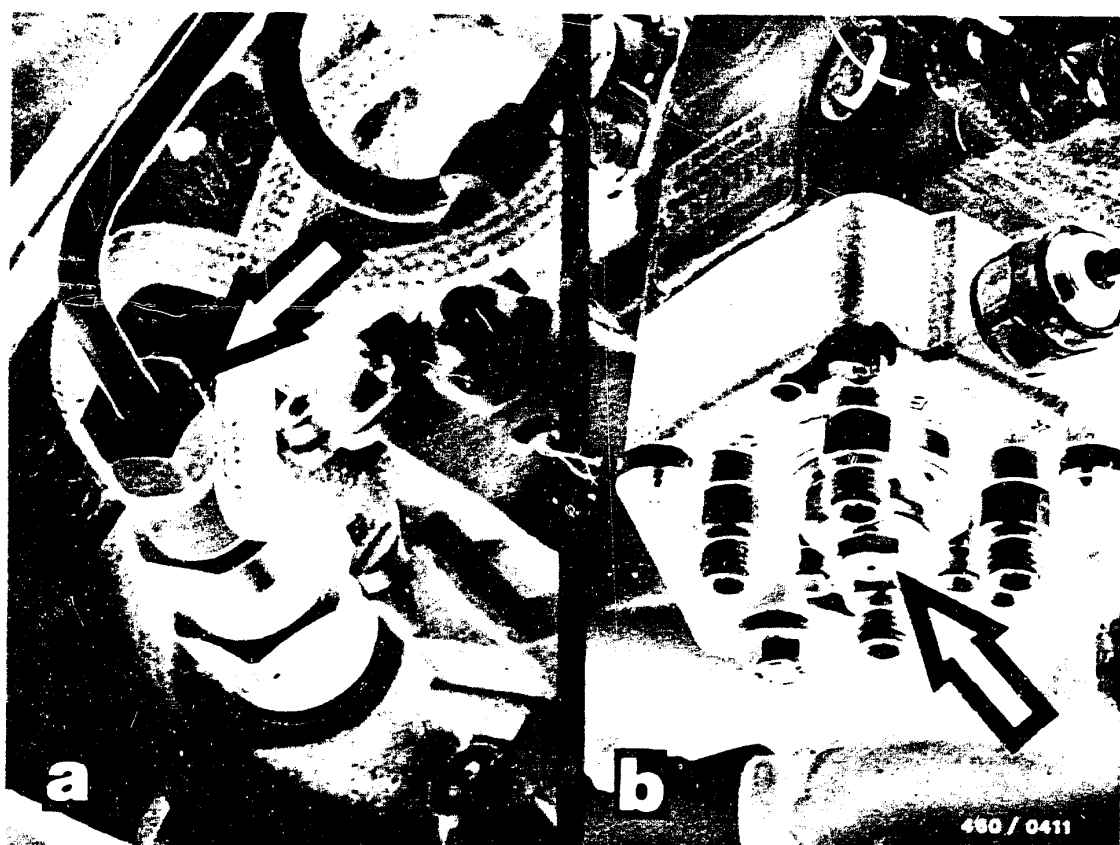
14. Bleeding fuel system

Fill fuel filter and injection pump with diesel fuel.

Tighten vent screw on fuel filter (shown at arrow in Fig. a).

Unscrew vent screw on injection pump several turns (shown at arrow in Fig. b).





Loosen delivery line union nuts on nozzle holders (shown at arrow in Fig. a).

Operate starter without pre-heating.

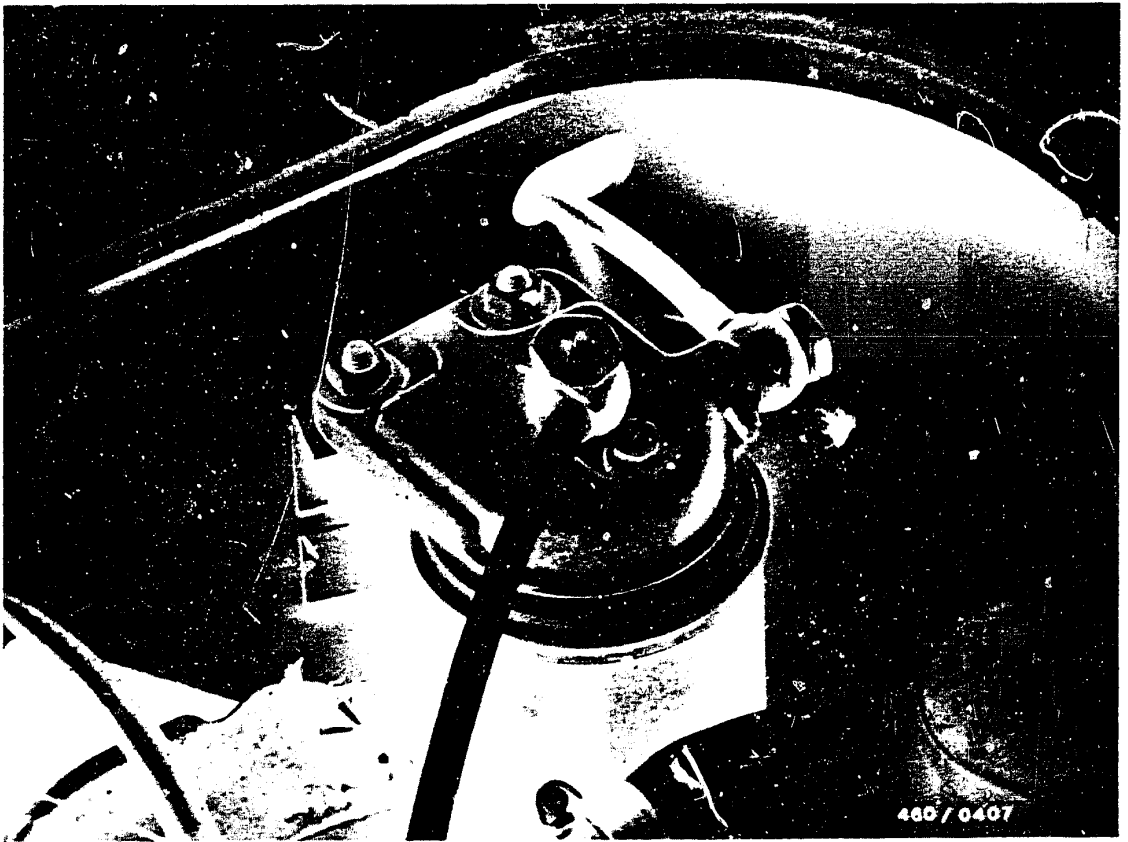
Tighten vent screw when fuel escaping through injection pump vent hole (shown at arrow in Fig. b) is free of bubbles.

Continue to operate starter until fuel escapes at nozzle holder union nuts.

Tighten union nuts.

Operate starter until engine starts.





15. Replace and drain water from filter box

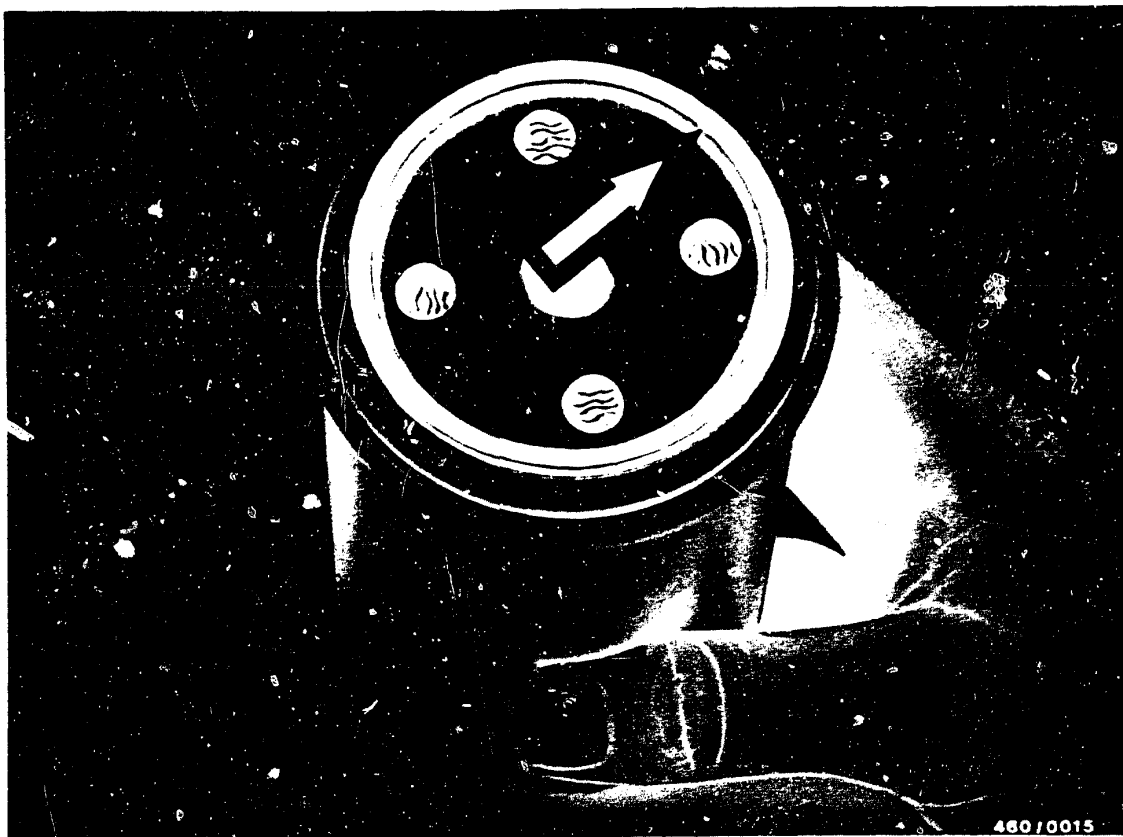
15.1 Replace filter box

Unscrew fuel filter out of filter cover.

If stuck, loosen filter box using special wrench, e.g. Matra W 167.

Catch escaping fuel.





Rub diesel fuel into the rubber seal (arrow) of the new filter box.

Screw the filter box into the cover by hand and tighten.

Check the fuel filter for leaks.

In the case of winter fuel it may be necessary to add petroleum as specified by the vehicle manufacturer.

B21

Replace and drain water from fuel filter
VW-Transporter





15.2 Drain water from fuel filter

Loosen bleeder screw (arrow) on the filter cover by a few turns.

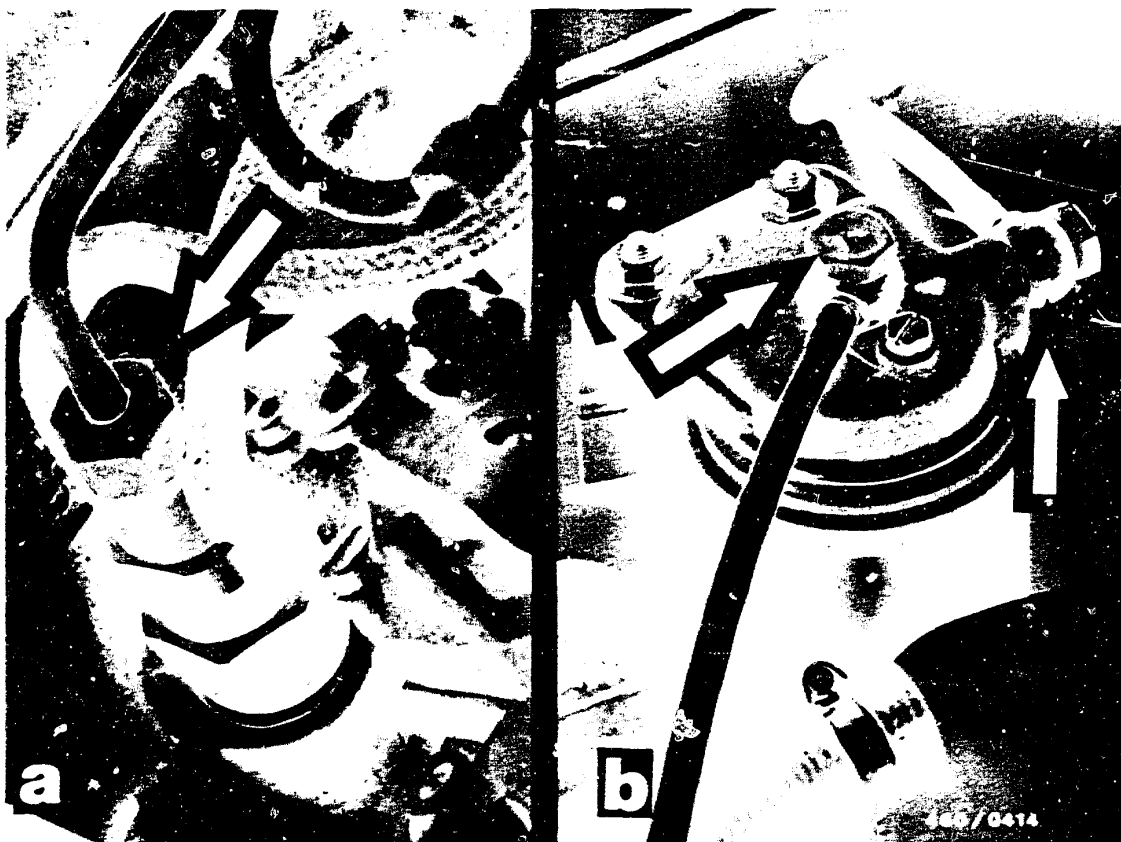
Loosen water-drain screw on the base of the filter and drain water.

Catch liquid in container.

Tighten water-drain screw and bleeder screw and check for leaks.

If necessary, bleed fuel filter.





16. Check fuel-injection system for leaks

Perform leak test with engine at normal operating temperature.

Examine all connection points of the fuel lines.
Pay particular attention to:

- Connections on nozzle-holder assemblies (Fig. a)
- Connections on fuel filter (Fig. b)





- Inlet and return lines on distributor-type fuel-injection pump.
- Delivery-valve holders on hydraulic head.

Perform visual inspection of fuel lines for hairline cracks.





17. Check fuel lines

Subject suspect fuel lines to a visual inspection.

If there is no detectable pinching or kinking, the fuel line in question must be removed.

Check fuel line for throughflow using compressed air and clean if necessary.

A suitable hose piece may be used as a side seal for blowing out the fuel lines.

C1

Check fuel lines
VW-Transporter



18. Smoke test - check air filter

18.1 Smoke test

Summary of the contents of the legal regulations (as at April 1978). Applicable to Federal Republic of Germany.

This regulation applies only to the homologation of motor vehicles having at least 4 wheels with a maximum permissible speed of more than 25 km/h. A smoke emission test is not prescribed for official general inspections.

Parts which may have an influence on environmental pollution must be designed in such a way that the legal requirements are met during operation and despite vehicle vibration.

This applies in particular to cold-start devices and full-load stops. The Rheinland-Westfälische TÜV (Technical Inspection Bureau of Rhineland-Westfalia) in Essen is the sole approval agency.

C2

Smoke test

VW-Transporter





18.1.1 Test setup

The smoke test is conducted using the Bosch filter-type smokemeter.

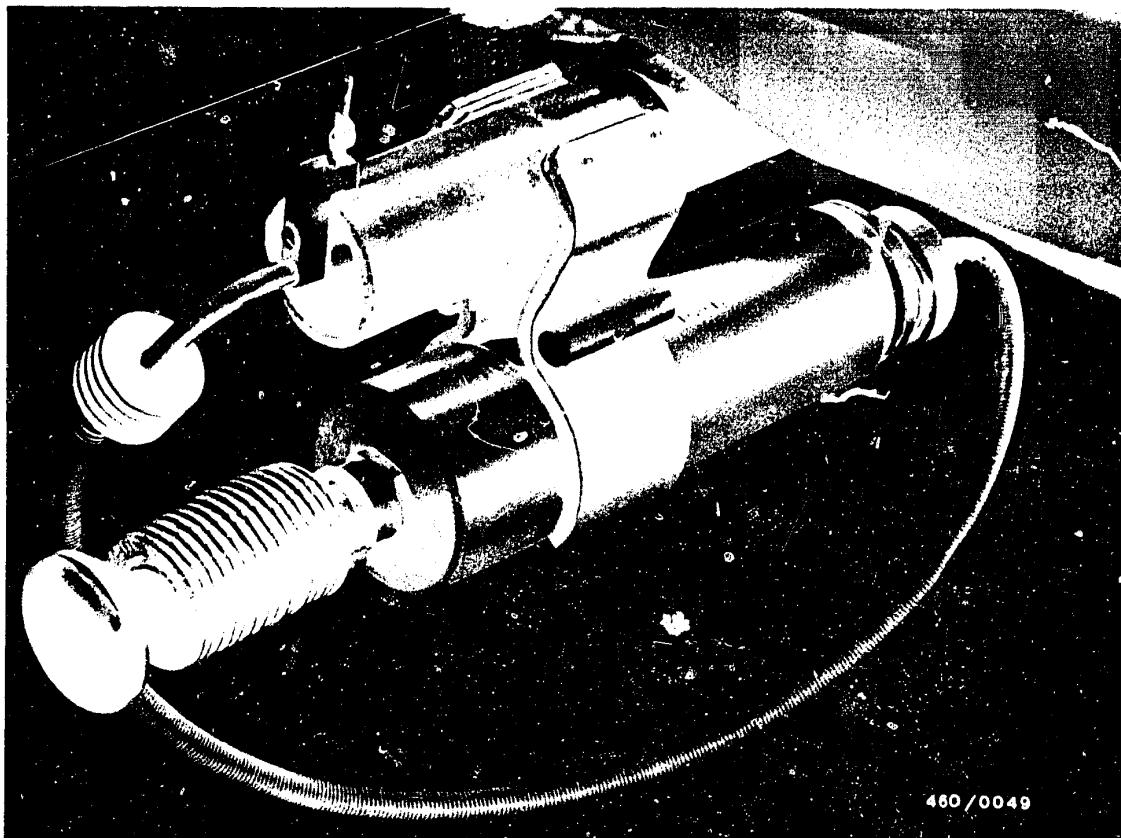
The filter-type smokemeter consists of the following units:

Accessories box with proportioning pump 0 681 169 038

Evaluating unit 0 684 102 050

Insert filter plate into proportioning pump.





Mount sampling pump on exhaust pipe using appropriate clamp.

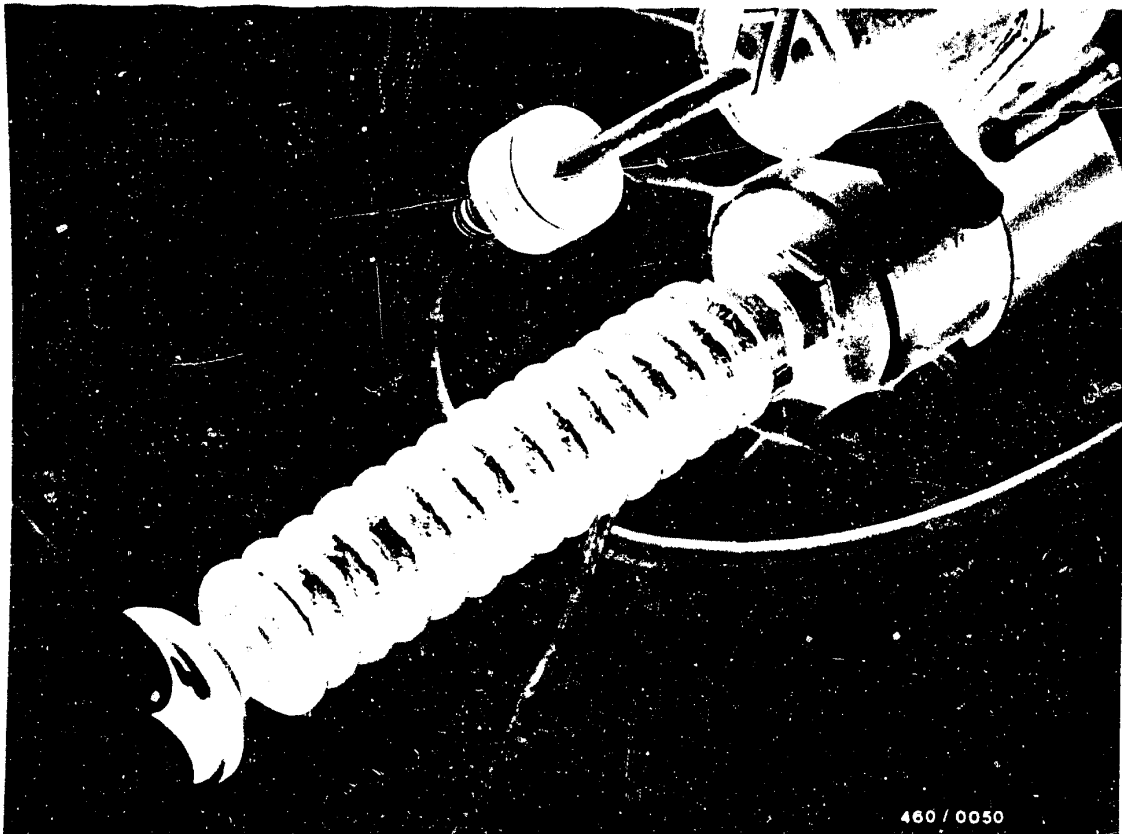
Introduce exhaust-sample pickup as far as possible into exhaust pipe and clamp in position.

C4

Smoke test

VW-Transporter





18.1.2 Test procedure

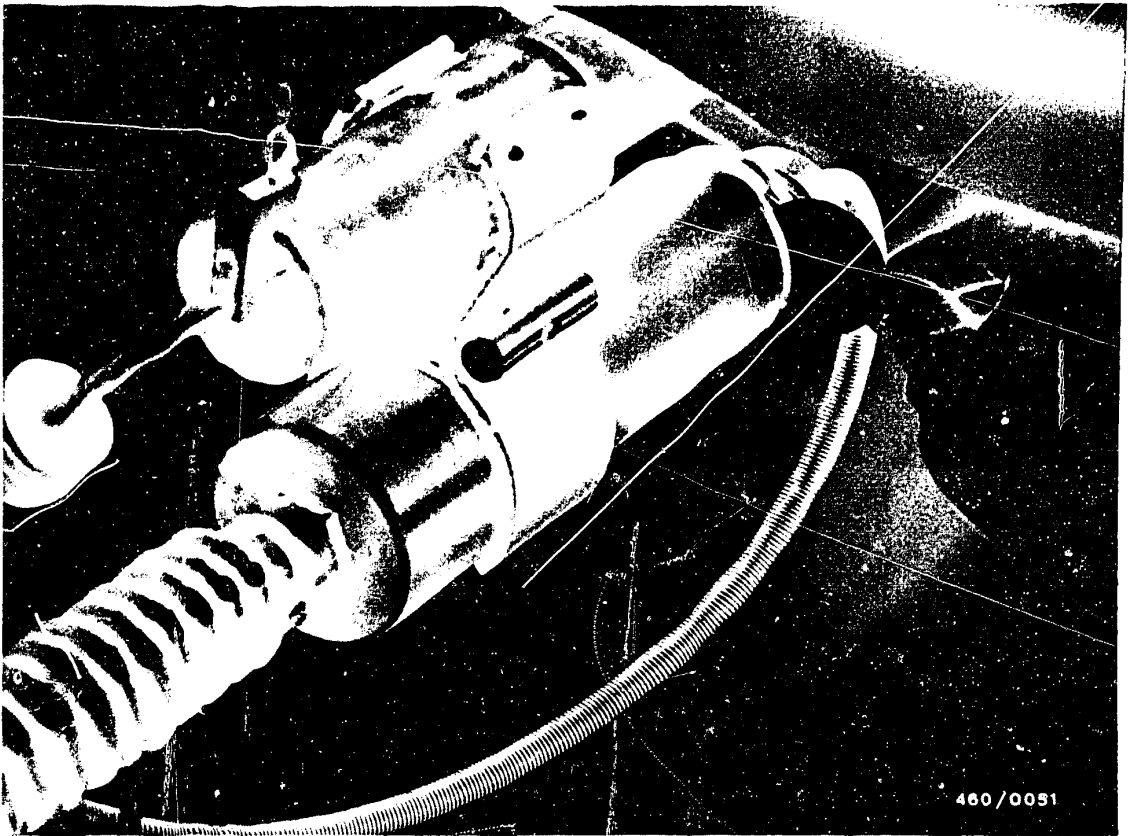
Set proportioning pump by pressing in the black push-button.

Take rubber ball on triggering hose and enter passenger compartment.

The test can be performed on the chassis dynamometer or on the road (gradient).

The chassis dynamometer is preferable in any case. Find the gear in which, with the accelerator pedal in the full-load position, a speed of approx. 40 km/h is reached. Load the engine so that, with the accelerator in the same position, a speed of approx. 25 km/h is reached.





Maintain this load condition for 5 seconds and then trigger the sampling pump by pressing the rubber ball.

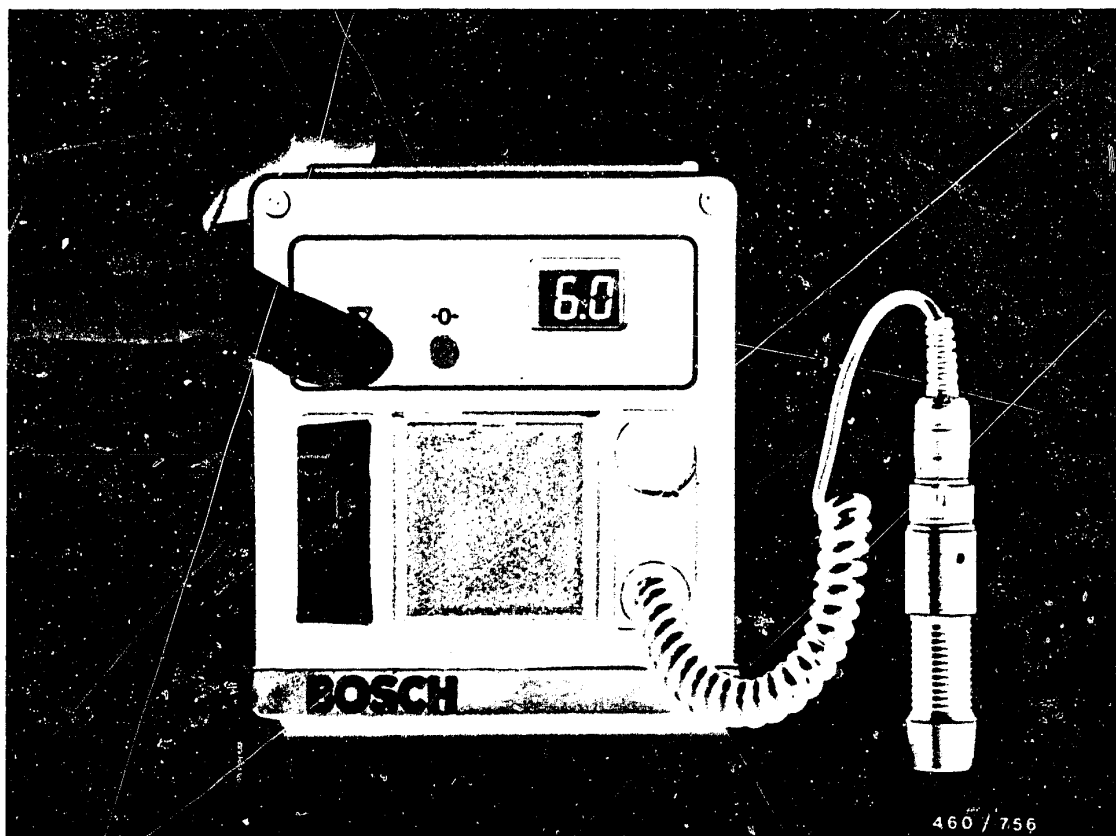
Switch off engine.

Caution!

During the following operation, pay attention to the fact that the exhaust pipe has been heated due to the running of the engine.

Remove filter plate from sampling pump.





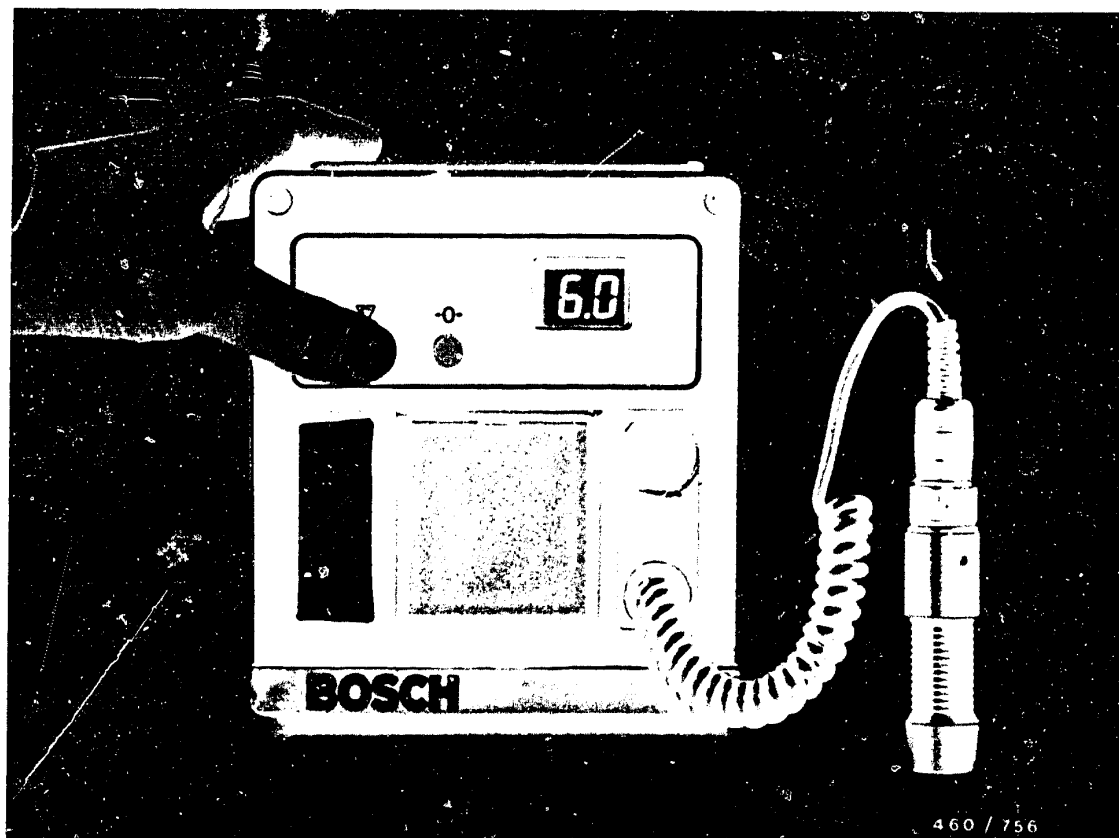
Setting the Zero Point

The zero point adjustment must be performed

- before each measurement series
- if there are changes in ambient conditions
- each time the lens of the photo-element adapter has been cleaned.

Firmly press the measuring head of the photo-element adapter onto 5 clean, white filter plates placed one on top of the other.

Press button "0" until display 0.0 appears.
Release button "0".



Measuring

With the sooted side at the top, lay filter plate from metering unit on 3 new filter plates placed one on top of the other.

Press measuring head vertically on to black surface of filter plate. At the same time, press button "C" until smoke number appears in display.

Note:

Measuring head must be firmly mounted both for the zero point adjustment and for measuring (even slight tilting may lead to incorrect measurements).

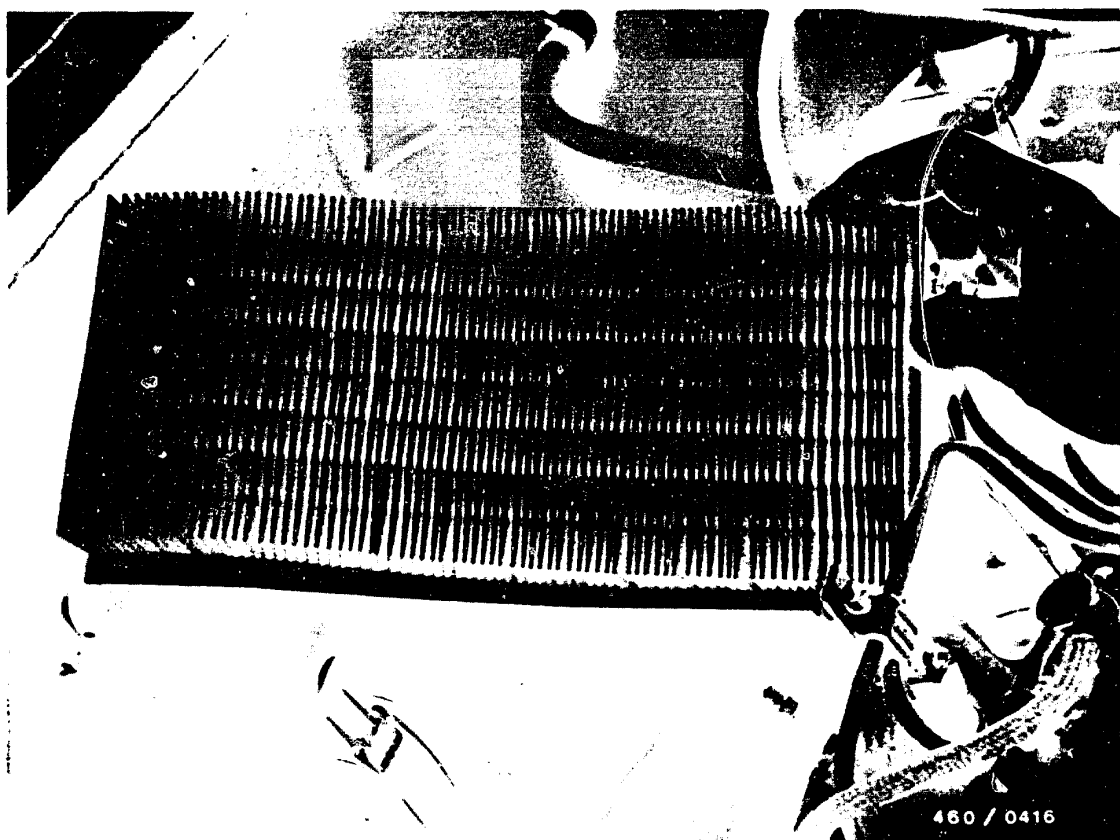
Compare the smoke number with the evaluation sheet.
Note kW (HP) information of vehicle manufacturer.

C8

Smoke test

VW-Transporter





18.2 Check air filter

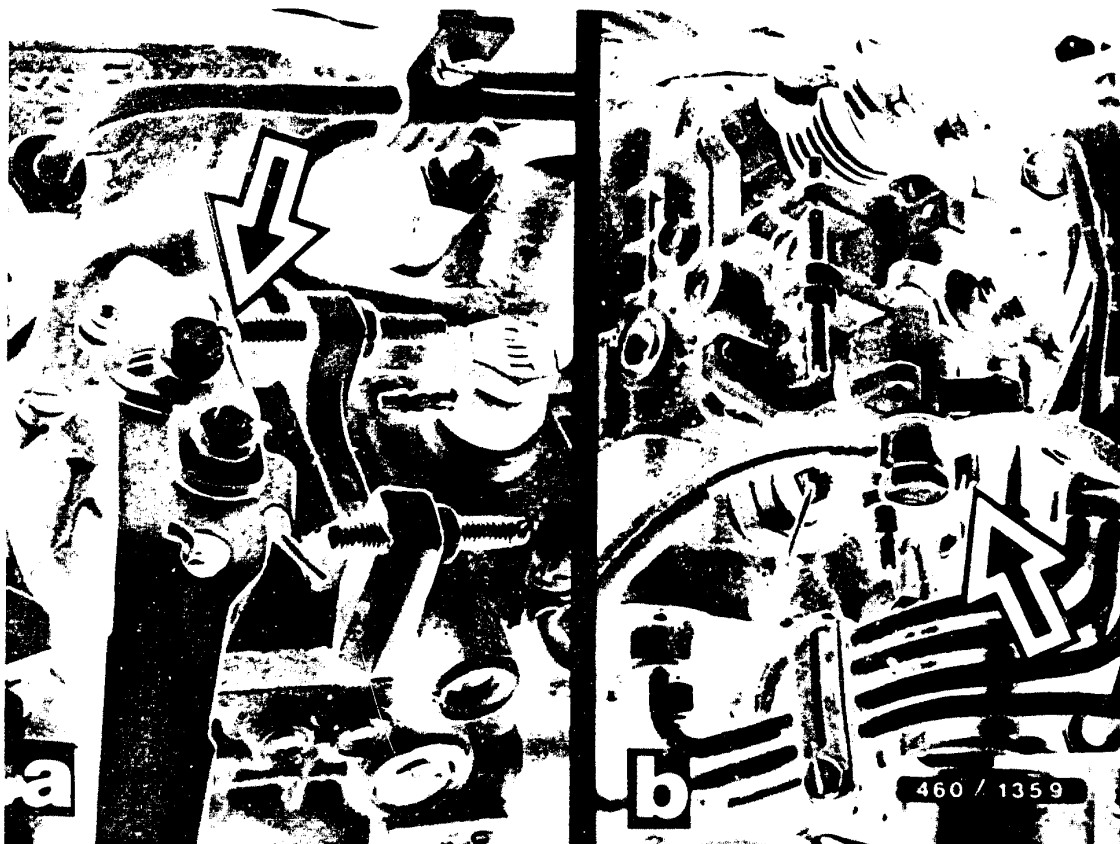
Remove air filter and subject to a visual inspection.

Test criteria for air filter:

- Dusty air filter
(Check by knocking out air filter).
- Oil-fouled air filter
- Solid matter in air filter, e.g. leaves

If in doubt, use new filter element.





a = Diesel

b = Turbo diesel

19. Adjust idle speed

Connect tachometer (e.g. photoelectric) to engine.
Start engine and run at idle speed.

Caution:

To adjust the idle speed, the engine must be at normal operating temperature.

Coolant temperature $+80^{\circ}\text{C}$

Set engine speed to $820 \pm 50 \text{ min}^{-1}$ at the idle-adjusting screw (arrow).

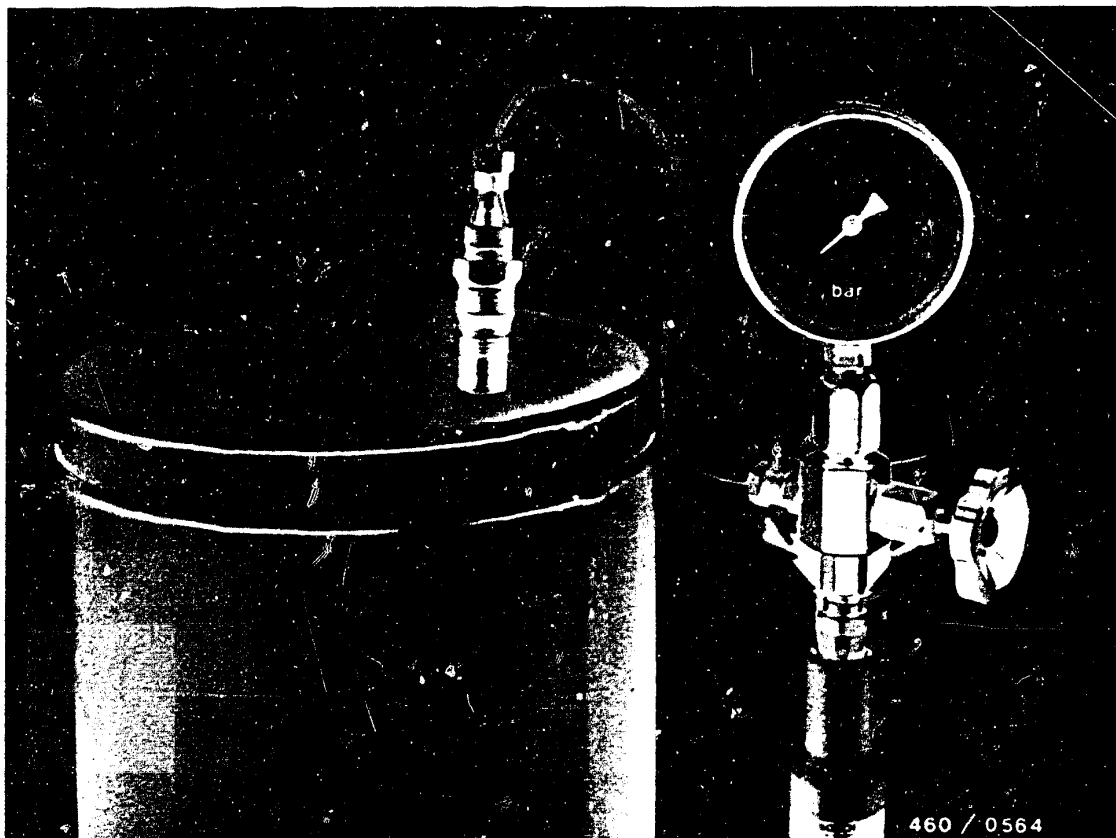
Note that the engine camshaft and fuel-injection pump are driven at half the engine speed.

After adjusting, lock adjusting screw and seal.

C10

Adjust idle speed
VW-Transporter





20. Test injection nozzles

Remove injection nozzles.

The test is performed using the nozzle tester EFEP 60 H 0 681 200 502.

Mount injection nozzle with nozzle-holder assembly on nozzle tester.

When testing injection nozzles, make sure that the fuel spray does not strike your hands since, due to the high pressure, the fuel will penetrate into the skin and may cause blood poisoning.



Instructions:

When checking fuel-injection nozzles, make certain that the fuel jet does not strike your hands, because, due to the high pressure, the fuel penetrates into the skin and can cause blood poisoning.

For testing, use pure calibrating oil per ISO 4113 or clean diesel fuel.

Test criteria:

- Opening pressure
- Leaks
- Chatter
- Spray pattern

20.1 Checking opening pressure

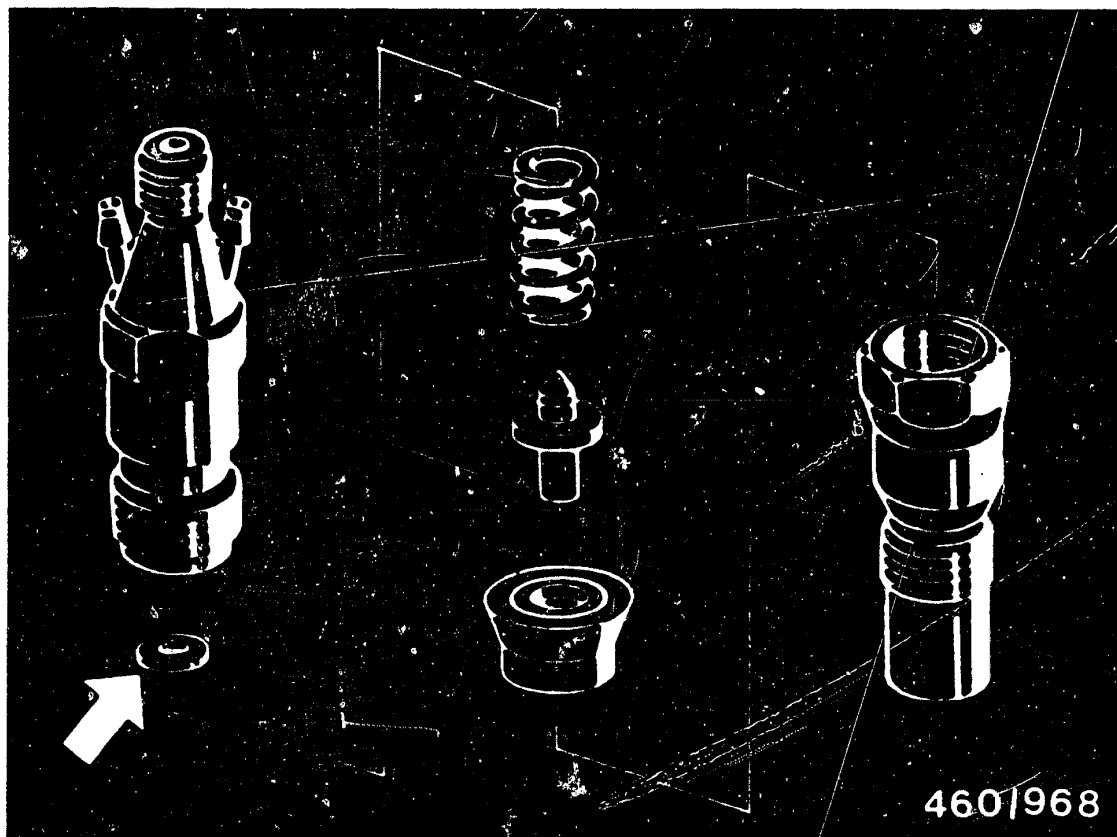
Open the spray valve on the pressure gauge by approx. 1/4 turn.

Slowly press down the manual lever on the nozzle tester (increased pressure on the pressure gauge).

Watch at which pressure the pointer of the pressure gauge stays (nozzle not chattering) or at which the pressure suddenly drops (nozzle chattering).

The maximum pressure attained in so doing is the opening pressure.





If there is a deviation from the specified value, correct the nozzle opening pressure by means of compensating washers behind the pressure spring (arrow).

Diesel

Injection pressure of new nozzles	130 + 8 bar
Injection pressure of used nozzles	120 bar

Turbo diesel

Injection pressure of new nozzles	155 + 8 bar
Injection pressure of used nozzles	140 bar

thicker washers = higher nozzle opening pressure
 thinner washers = lower nozzle opening pressure

Changing the spring travel by +/- 0.05 mm changes the nozzle opening pressure by approx. 5.0 bar.



20.2 Checking for leaks

Open the shutoff valve on the pressure gauge by approx. 1/4 turn.

Dry off the lower portion of the nozzle and nozzle-holder assembly. (Blow it dry with air.)

Slowly press down on the hand lever until the pressure gauge indicates 20 bar less than the opening pressure as read above. The nozzle does not leak if there is no drop dripping from the nozzle opening within 10 seconds.

If a drop drips off, take the nozzle-holder assembly combination apart and clean it.

If the leak is still there, take out and replace the nozzle.

It is not permissible to remachine the parts of the nozzle.

Note:

Striation on the holder assembly and the intermediate disc can be machined off provided the necessary care is taken (other than during the warranty period).



20.3 Chatter test - Evaluation of the spray pattern

General information:

When evaluating nozzles, make a distinction between new and used nozzles.

Switch the pressure gauge off.

New nozzles:

The chatter test makes it possible to test for ease of movement for the nozzle needle in the nozzle body by means of listening. If the nozzle does not chatter in spite of cleaning, it is to be replaced with a new nozzle. In the chatter test, the shape of the spray is of no significance. A spray pattern corresponding to specifications is generally present only with new nozzles.

Used nozzles:

The chatter behavior of the nozzle deteriorates due to wear in the area of the seat. When the lever is moved quickly, the nozzle must chatter audibly and/or spray a well-atomized spray.

In the case of used nozzles, the spray pattern can deviate from the ideal shape from a new nozzle. The spray pattern from such nozzles however can be perceptibly improved by appropriate cleaning.



20.4 Chatter and spray test (nozzle-type related)

This concerns pintle nozzles with throttling action which are installed in all engine types.

These nozzles have a special base form and an additional spray hole through which the prespray escapes.

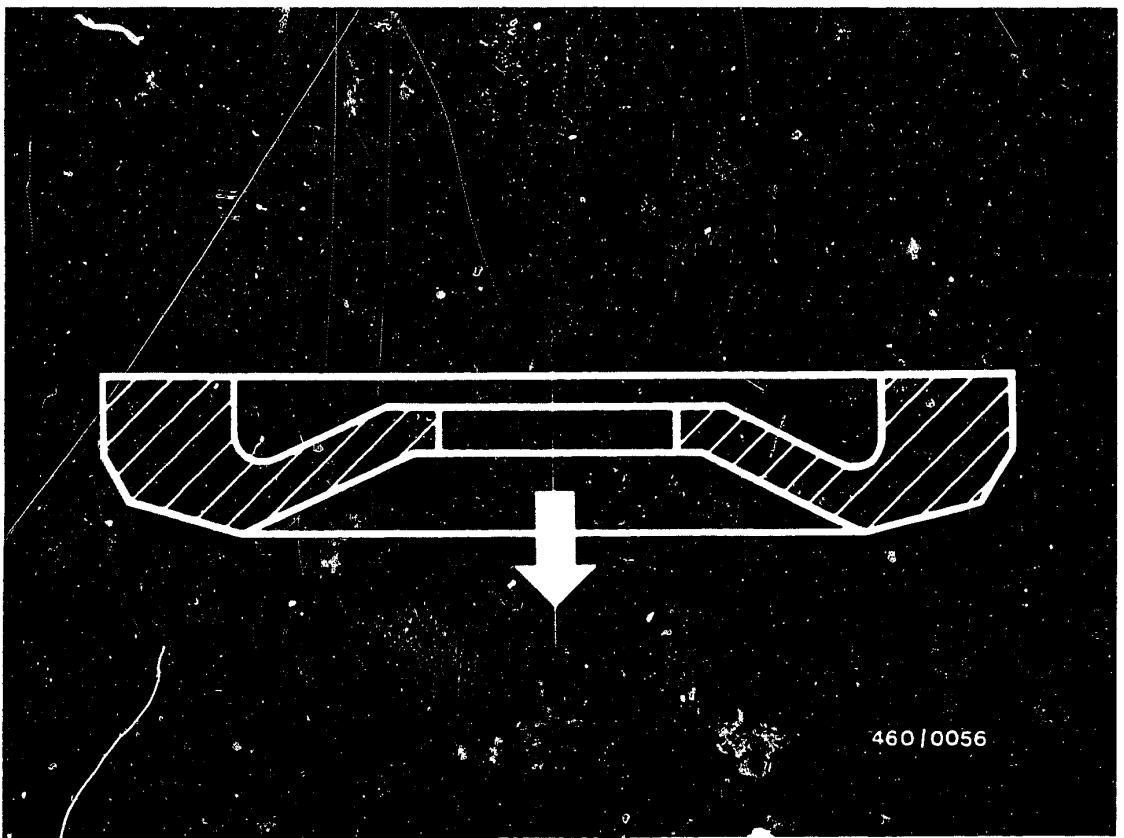
Chatter test:

Due to its special structural features this nozzle chatters very softly. A chatter test is possible with this nozzle only between 1...2 downward movements of the hand lever per second. As the test speed is raised the chattering stops. The calibrating oil then escapes with a hissing noise from the nozzle. The nozzle chatters with a high whistling tone only with rapid movement of the hand lever (about 4...6 downward movements per second).

Spray pattern: (applies only to new nozzles)

At low test speed the major portion of the delivered fuel must escape through the lateral prespray hole, well atomized. An evaluation of the main spray is only possible when the hand lever is moved rapidly (approx 4...6 downward movements per second). The spray must be concentrated and well atomized.





20.5 Putting in the fuel-injection nozzles

Before installation of the fuel-injection nozzles, put in a new heat insulator disc in the cylinder head as a shield and lateral compensation for tolerances (sealing cone 150° in the direction of the arrow).

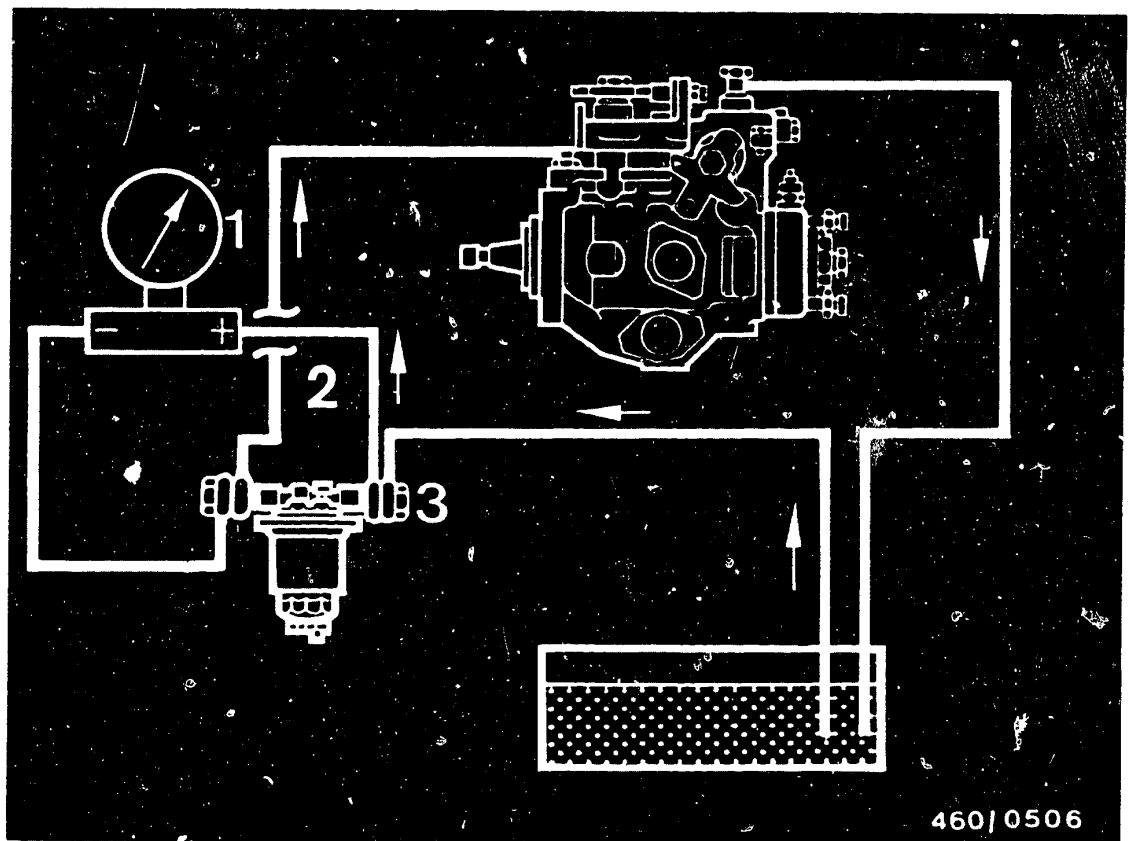
Then screw the nozzle holder into the cylinder head and tighten it to 70 Nm.

Note:

If the tightening torque is exceeded, the nozzle needle can jam.

Tighten union nuts on the supply lines to 25 Nm.





460/0506

- 1 = Differential pressure gauge
- 2 = Filter outlet
(Use inlet union and overlong inlet-union screw 2 443 456 020.)
- 3 = Filter inlet
(Use inlet union and overlong inlet-union screw 2 443 456 020.)

21. Connection diagram for filter test (differential pressure test)

Connect the differential pressure gauge to the fuel filter using appropriate connectors.





Connect (+) side of differential pressure gauge to fuel filter inlet.

Connect (-) side of pressure gauge to filter discharge.

Observe connection diagram.

Allow engine to run until all air has escaped from fuel system.





Operate injection pump control lever briskly (1 sec-
ond) from idle stop to maximum speed stop.

Release control lever and read off differential pres-
sure on pressure gauge.

Differential pressure must not exceed 0.3 bar. If
pressure is greater, replace filter.

Remove test connections.

Bleed fuel system if necessary.

C20

Check fuel filter
VW-Transporter



22. Check pre-heating system

22.1 Necessary test equipment

Voltmeter/ammeter e.g. ETT 011.00 0 684 101 100

22.2 Workshop information

22.2.1 We recommend the "R"-type sheathed-element glow plugs be replaced every 45.000 km.

22.2.2 Preheating times

The on-time of the preheating system is dependent on the coolant temperature.

Test conditions

Battery fully charged.

Compression O.K.; if necessary, check compression loss.

Fuel supply/injection system O.K.



Starting motor operates / engine fails to start or starts only with great difficulty

All engines are equipped with a rapid-start preheating system.
Checking of glow-duration relay and glow-plug indicator lamp

Connect test lamp to electrical connection of a sheathed-element glow plug and ground.

Turn glow plug and starter switch to preheating position.

Test lamp and glow-plug indicator lamp do not light up.

Only glow-plug indicator lamp lit.

Only test lamp lit.

Test lamp and glow-plug indicator lamp lit?

no

Test lamp and glow-plug indicator lamp not lit.

1. Check for open circuit in lead between fuse box and glow-duration relay term. 86.
Eliminate open circuit.

2. Check for open circuit in lead term. 85 on glow-duration relay.
Eliminate open circuit.

3. Glow-duration relay defective; replace.

Only glow-plug indicator lamp lit.

1. Check for open circuit in lead between positive battery terminal and glow-duration relay term. 30.
Eliminate open circuit.

2. Check 80 A fuse for open circuit.
Replace fuse.

3. Check for open circuit in lead between glow-duration relay term. 87 and low plug.
Eliminate open circuit.

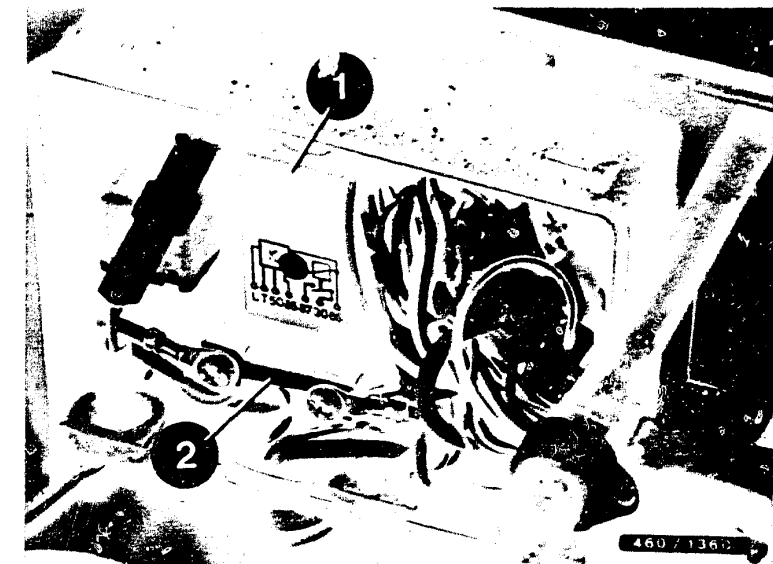
Only test lamp lit.

1. Disconnect plug from glow-duration relay and ground orange-colored lead through test lamp.

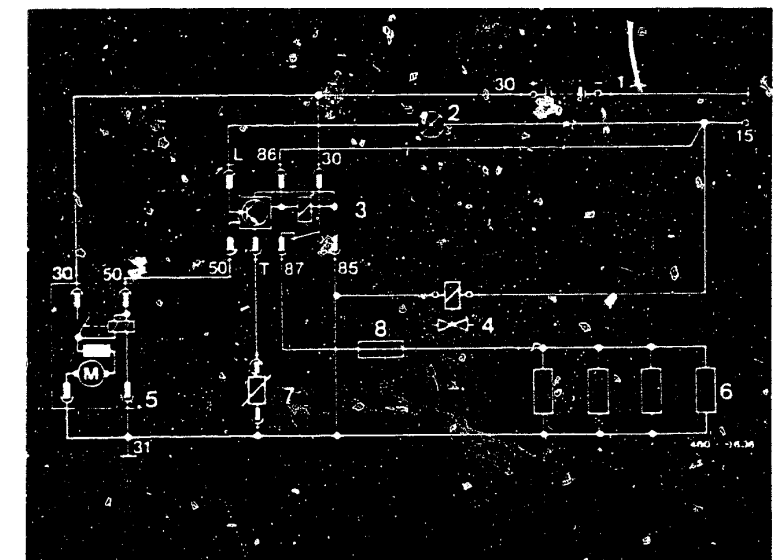
Indicator lamp lit and test lamp glowing? Control unit defective, replace.

2. Check indicator lamp or lead to indicator lamp for open circuit.

Eliminate open circuit.



1 = Glow-duration unit
2 = Fuse 80 A



C22

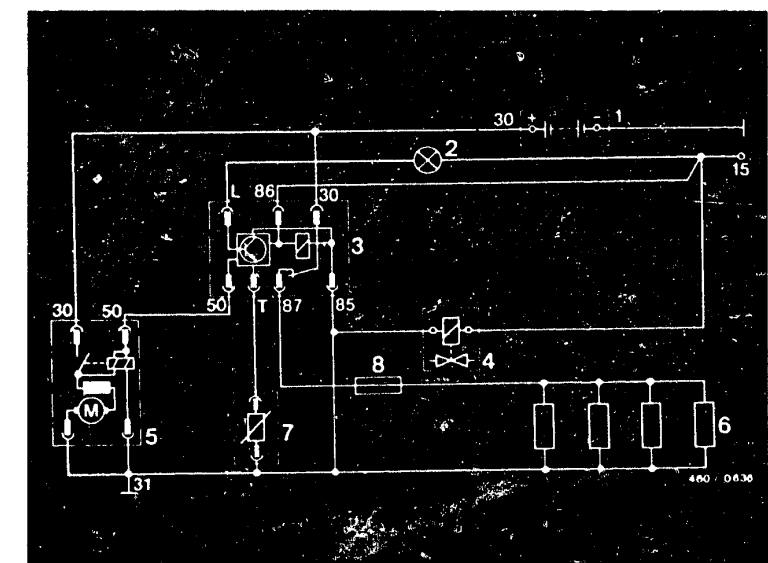
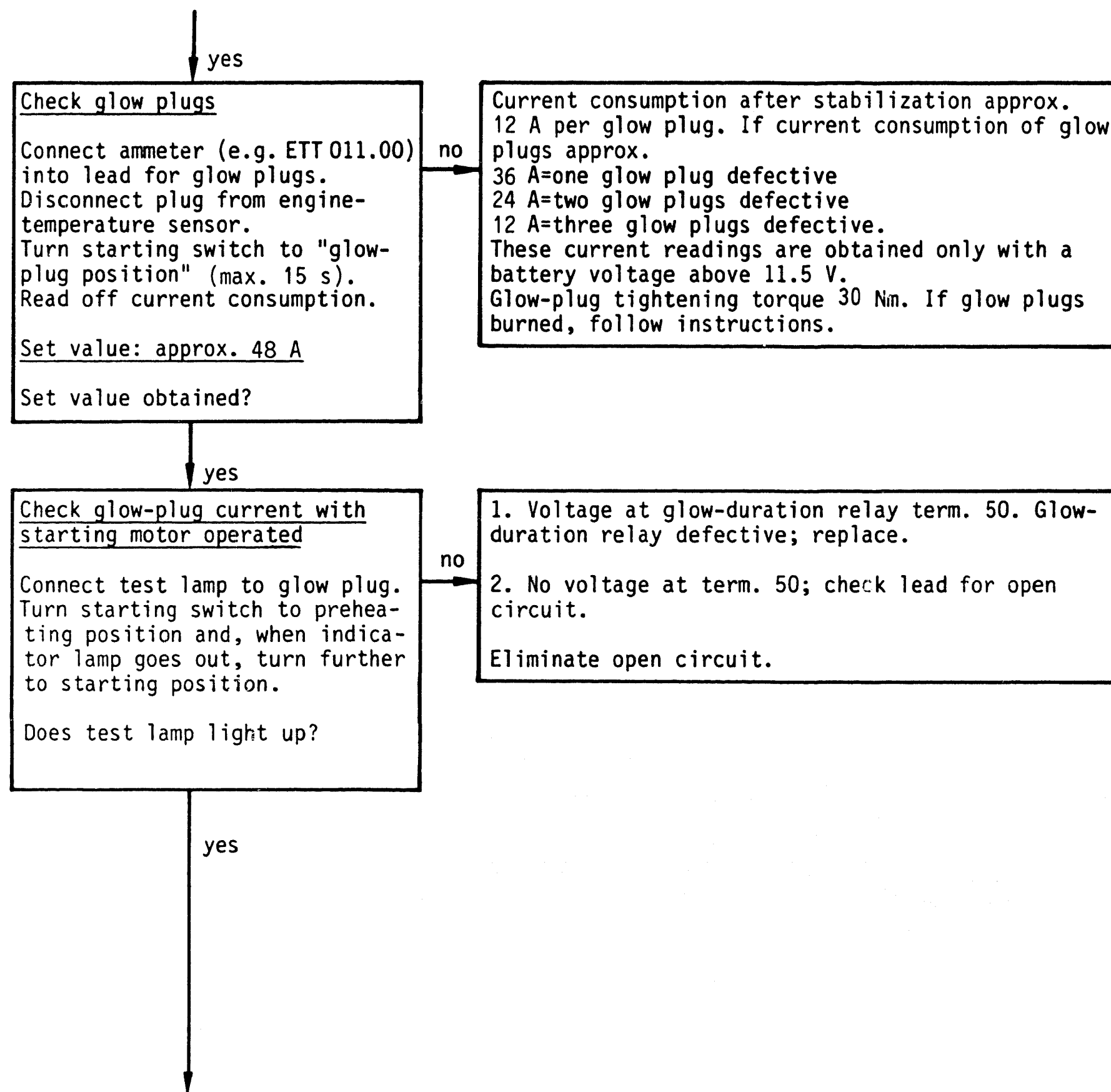
Check preheating system
VW-Transporter



C23

Check preheating system
VW-Transporter





D1

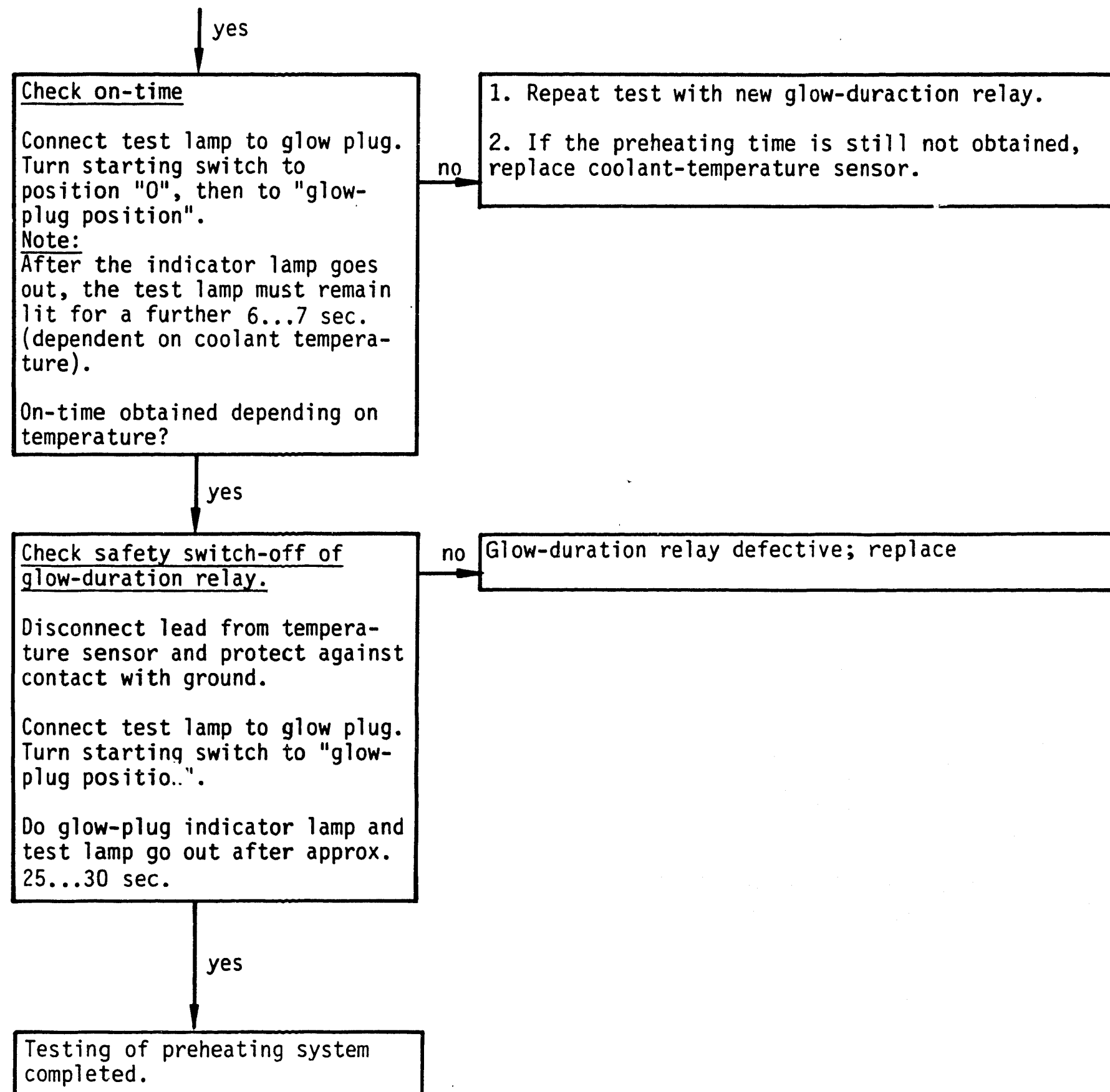
Check preheating system
 VW-Transporter



D2

Check preheating system
 VW-Transporter





D3

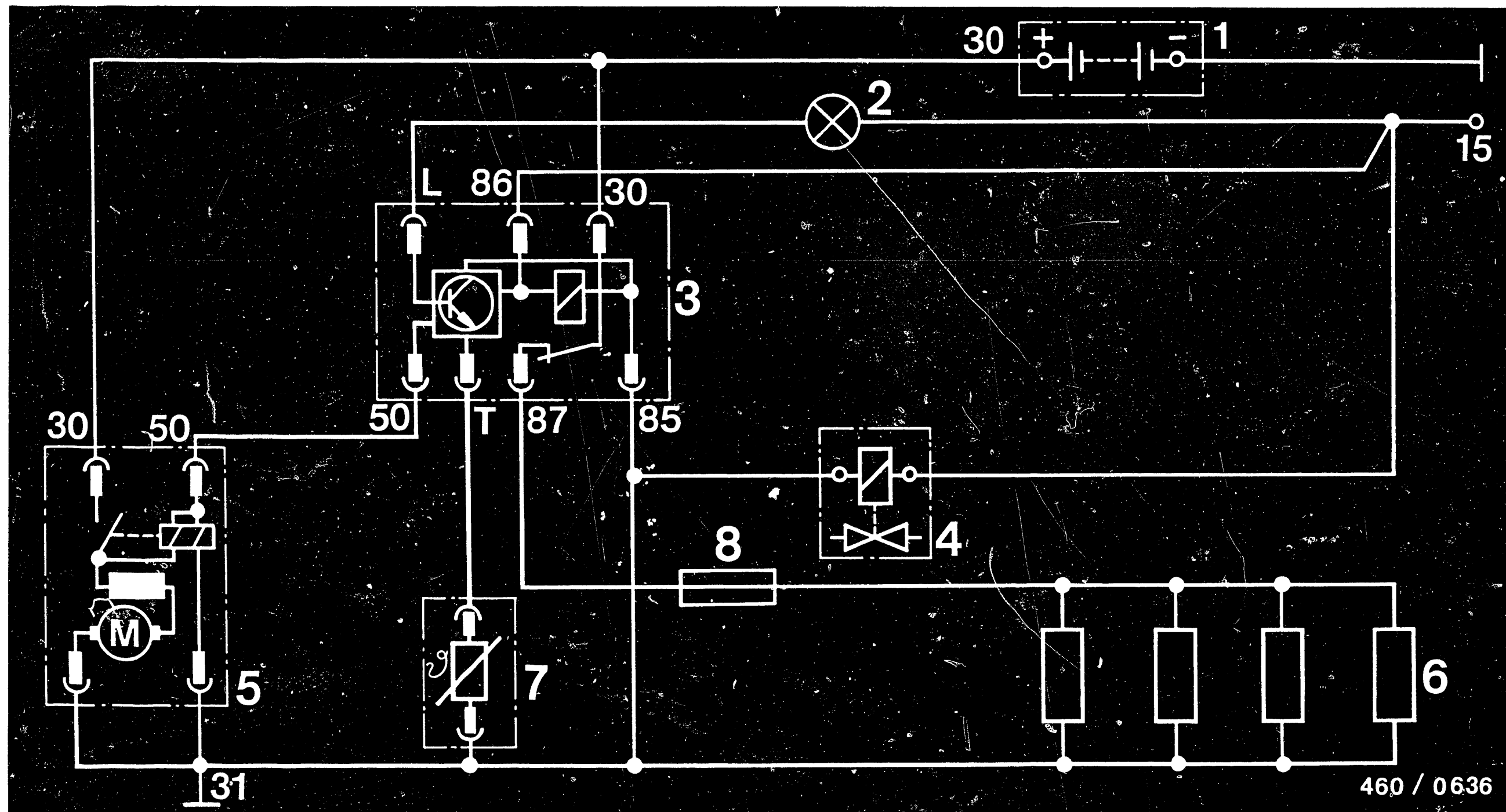
Check preheating system
VW-Transporter



D4

Check preheating system
VW-Transporter





- 1 = Battery 3 = Glow duration control unit 5 = Starter 7 = Temperature sensor
 2 = Visual indicator 4 = Solenoid-operated valve 6 = Sheathed-element glow plugs 8 = 80 A fuse

22.3 Wiring diagram for pre-heating system

D5

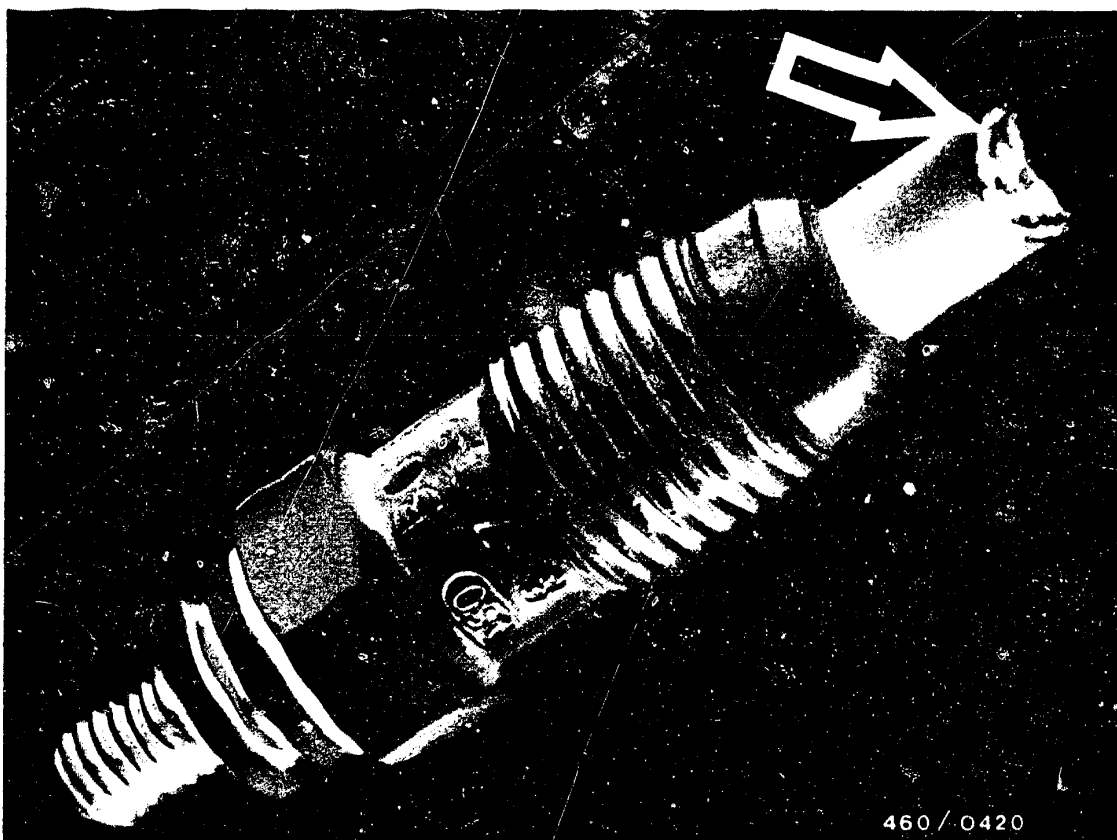
Check preheating system
 VW-Transporter



D6

Check preheating system
 VW-Transporter





460 / 0420

Note:

Glow plugs with burned heating elements

Glow plugs with burned heating elements are often the result of nozzle malfunction.

If plugs with burned elements are found(see photo), it is not sufficient simply to replace them. The nozzles must also be checked for spray pattern, chattering, pressure and leaktightness.

D7

Check preheating system

VW-Transporter



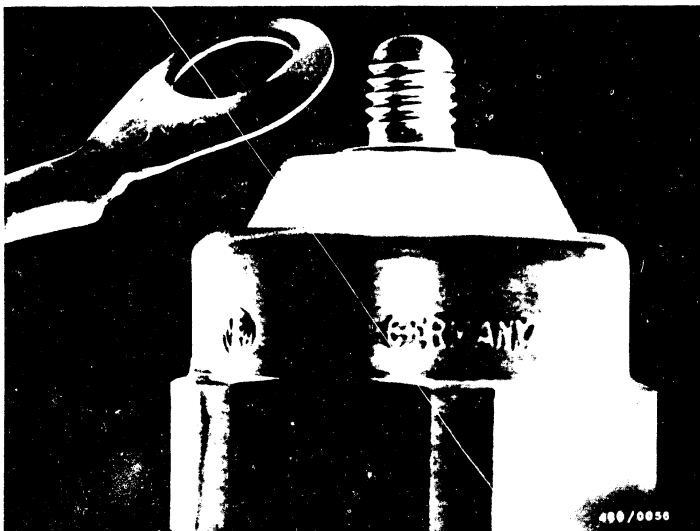
23. Testing injection timing device

Series VE..F.. distributor-type injection pumps have built-in injection timing devices.

The injection pump must be removed to test the timing device.

The timing device is tested on the injection pump test bench.





24. Measuring engine compression and pressure loss

24.1 Measuring engine compression

Place new recording card in compression tracer.

Attach high-pressure hose to tracer.

Turn off engine.

To avoid injection of fuel, remove lead from shutoff solenoid of distributor-type injection pump (see photo).



Unscrew nozzle holder.

Crank engine several times with starter to remove loose deposits from compression chamber.

Screw in nipple, 622 010 3219. (Check for tight seal when screwing nipple into nozzle holder hole).

Attach high-pressure hose of compression tracer to nipple.

When performing the following steps, pay particular attention to the first compression stroke.

Operate starter until indicated pressure on compression tracer stops rising.

Relieve compression tracer by pressing vent valve.

Tracer needle returns to initial position.

Move recording card to next position.

Screw nipple into remaining cylinders and repeat above procedure.

Compression	Permissible cylinder deviation
28 ... 34 bar	max. 5 bar



24.1.1 Evaluation of recording card

1. Normal pressure rise

If piston rings and valves are good, the first compression stroke will show the greatest pressure increase. Each succeeding stroke increases the compression until maximum pressure is reached.

2. Step-by-step pressure rise

If the compression increases in steps with each stroke beginning with the first, this indicates burned valve seats or faulty valve guides.

3. Low maximum pressure

If the maximum compression of all cylinders is too low, this indicates defective pistons, piston rings or valves.

Insufficient compression in two adjacent cylinders indicates a leaky head gasket.



4. Non-uniform compression

If one cylinder shows significantly lower compression, proceed as follows:

Add 2 ... 3 cm³ of engine oil through sheathed-element glow plug or nozzle holder hole. Operate starter briefly.

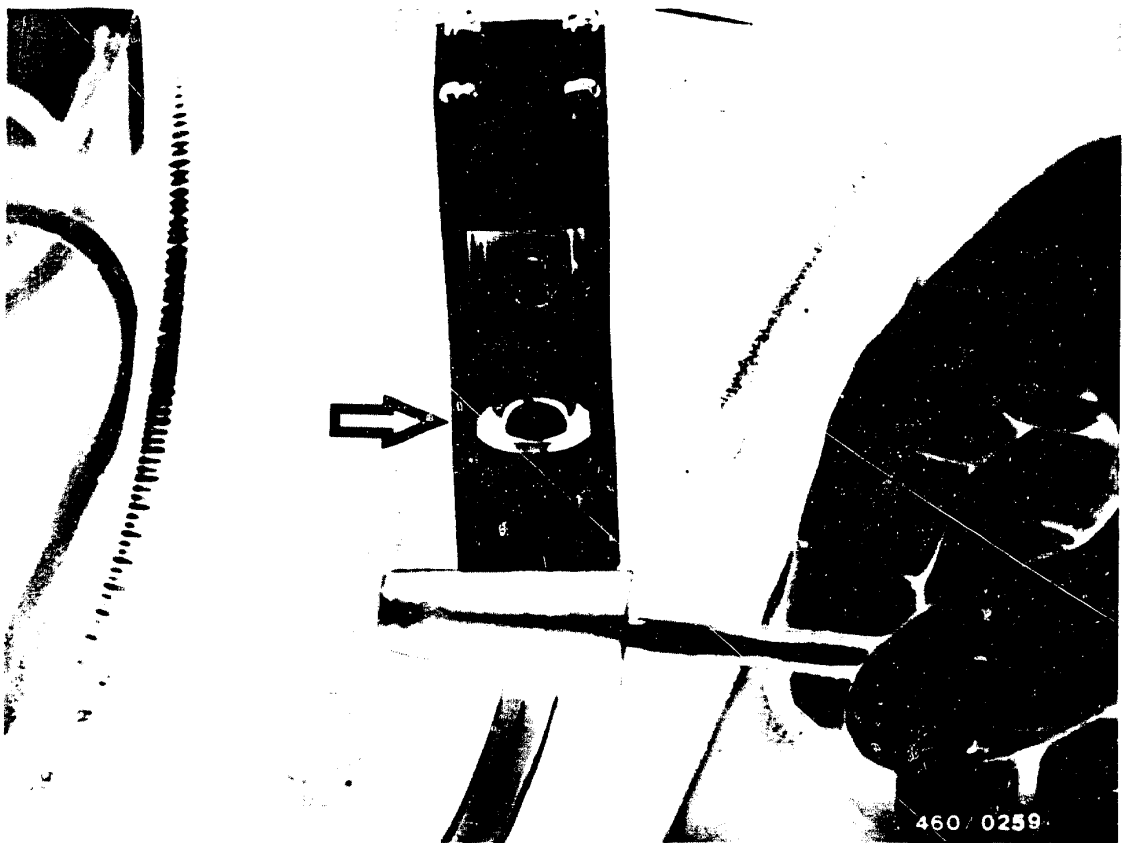
Repeat tests and compare recording cards. If the second test indicates significantly higher compression, the cylinder or piston rings are worn.

If the results are the same, bad valves are the problem.

5. Uniform compression

Uniform compression, in addition to compression which is as high as possible, is also very important for smooth engine performance.





24.2 Measuring engine compression loss

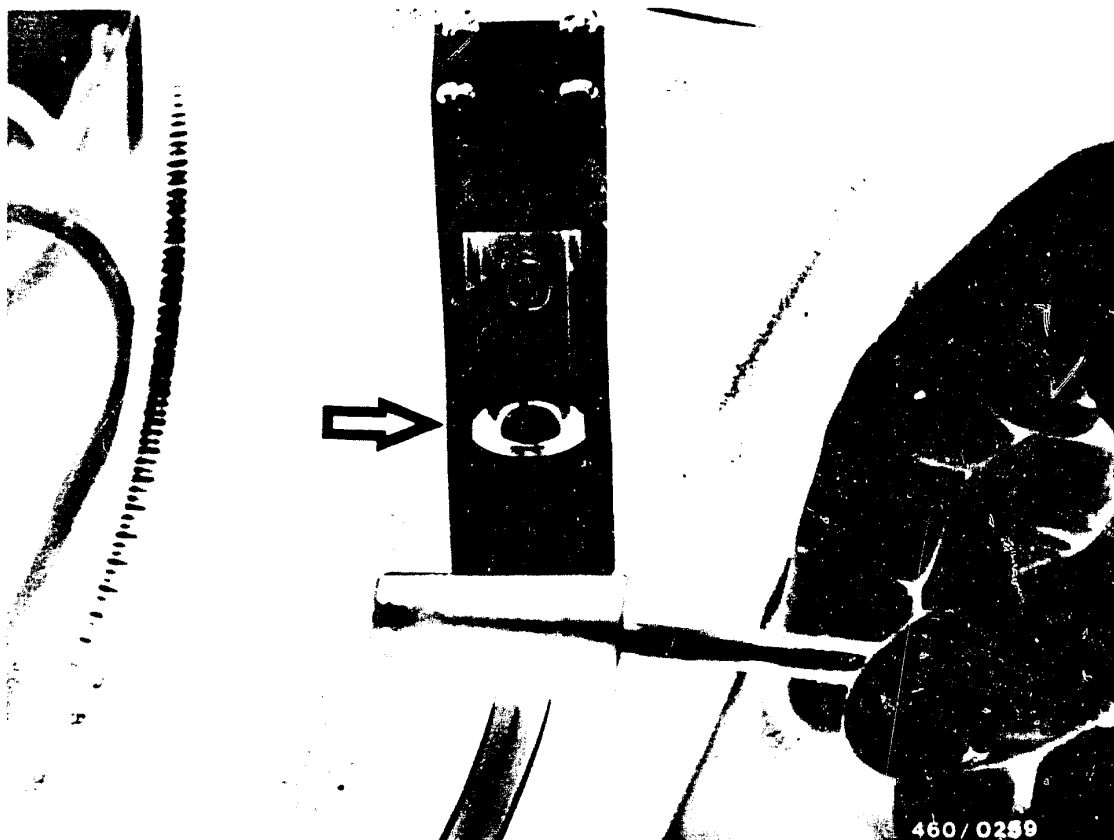
Compression loss is measured using BOSCH compression loss tester 0 681 001 901 (EFAW 210 A).

Cylinders must be measured at TDC.

TDC can be located using dead center (DC) finder 1 688 132 025 (included with compression loss tester).

Make measurements with engine at operating temperature (water temperature approx. 80°C).





24.2.1 Locating TDC

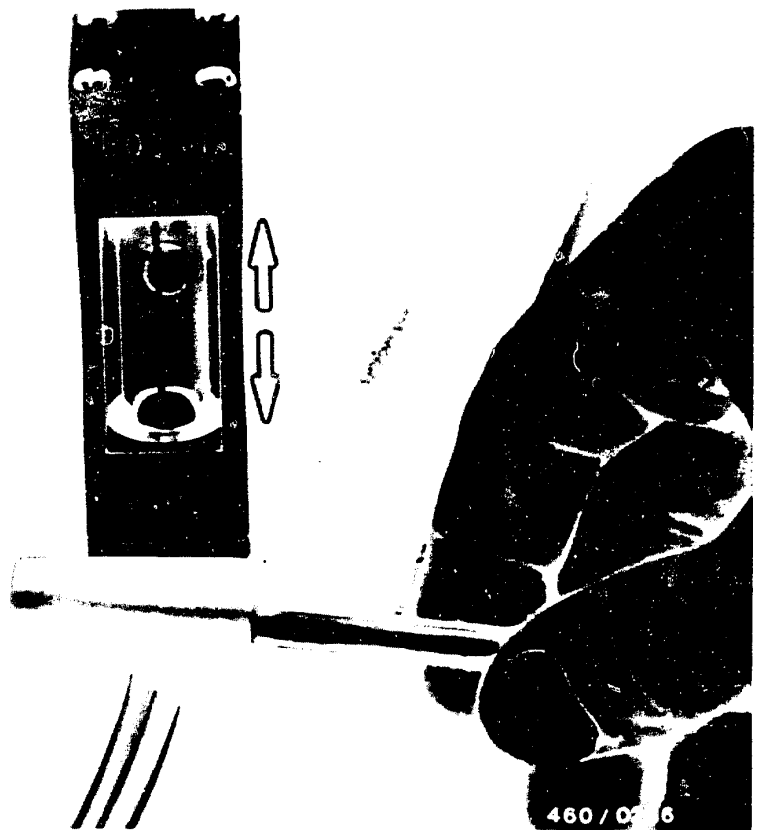
Remove sheathed-element glow plug from 1st cylinder.

Place rubber plug of DC finder in glow plug hole.

Attach glass cylinder with magnet in as vertical a position as possible in engine compartment.

The piston of the unit must be clearly visible.

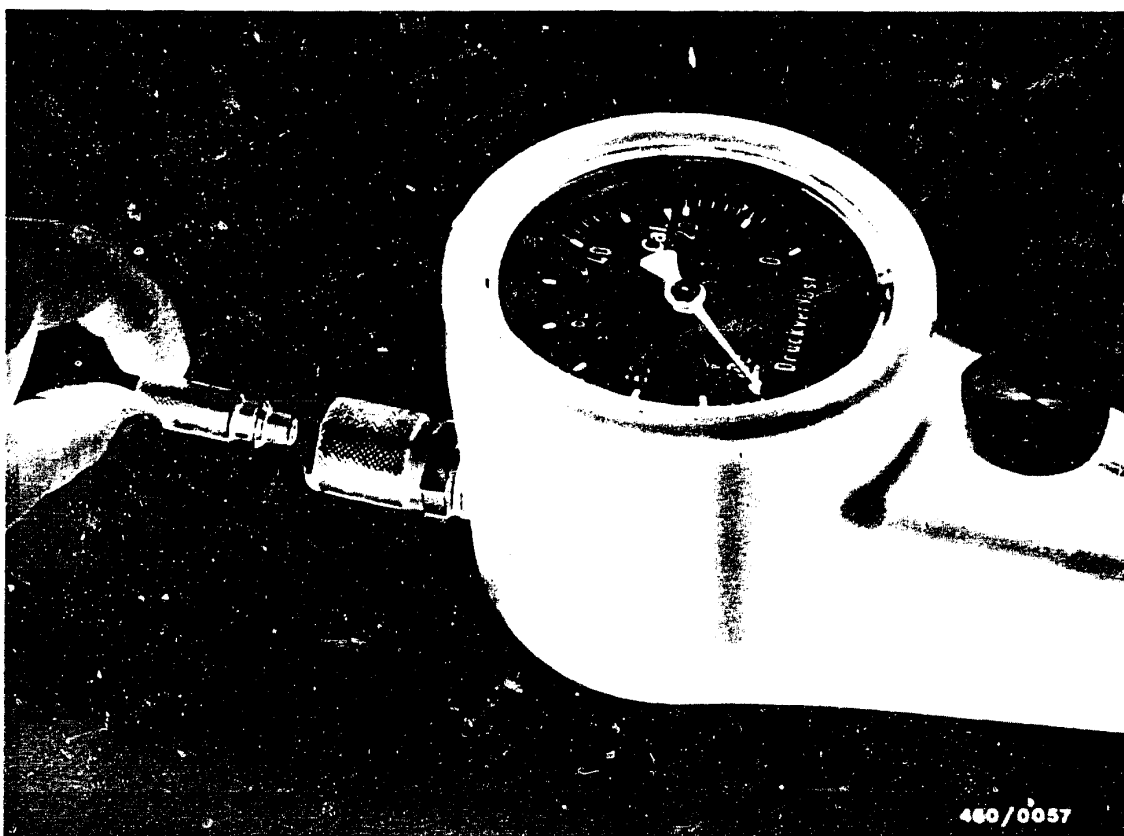
Turn engine by hand in normal direction of rotation.
(If necessary, shift into gear and push vehicle.)



During the compression stroke the piston of the DC finder is pushed upward.

If the cylinder piston moves past TDC, the piston of the DC finder moves downward immediately.

Find TDC by carefully rotating crankshaft back and forth.



24.2.2 Measuring pressure loss

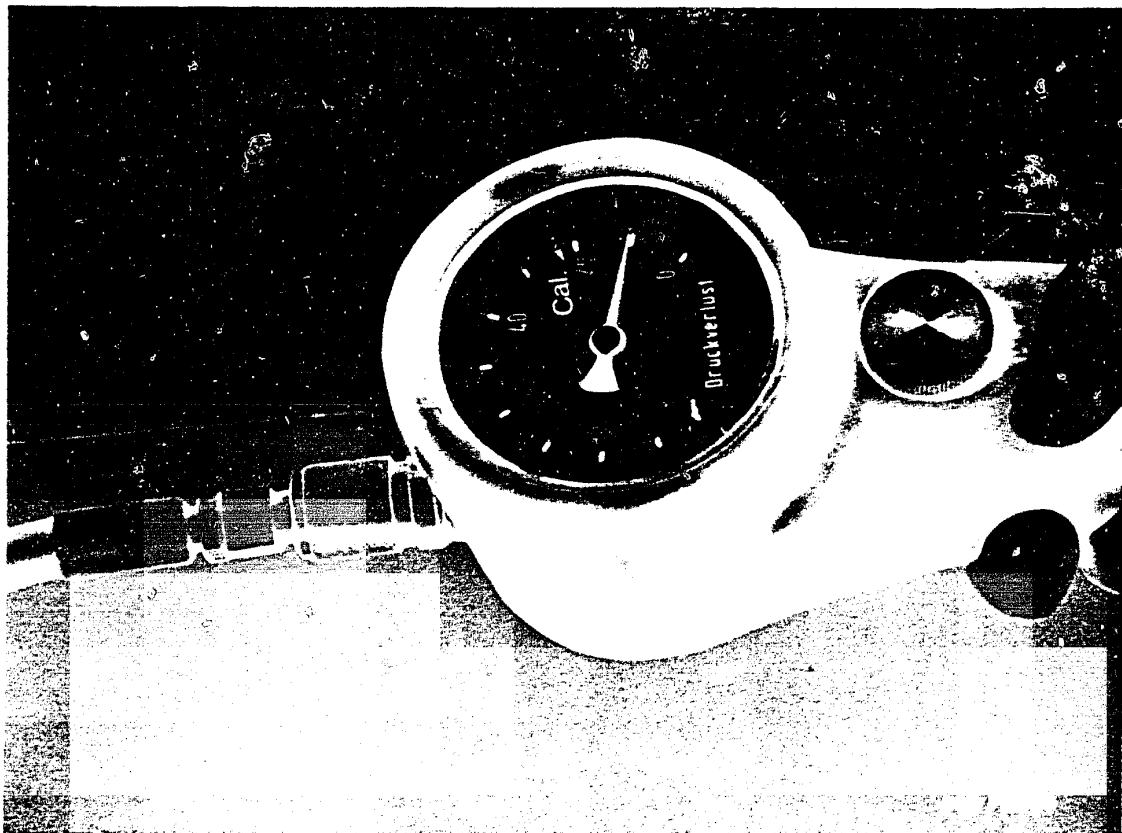
Connect tester to shop air supply.

Connect test nozzle 1 680 363 036.

Set pressure loss to 23 ±1% ("Cal." marking) with knurled screw of pressure regulator.

(Pointer must indicate pressure loss approaching 0% -- tester check.)





Screw in fitting and mount test hose.

Select gear and pull on handbrake.

Connect test hose to tester.

Read off compression loss in % on instrument.

Note:

Before measuring the next cylinder, briefly turn the engine over with the starting motor without preheating so that the oil film re-forms.



24.2.3 Evaluation of test

The indicated compression loss should not exceed 25 %.

Differences between the individual cylinders of 10 % are of no importance.

In the case of major compression loss, this can be located because the escaping air causes a noise.

Listen at the following points:

<u>Source of noise</u>	<u>Possible cause</u>
Intake manifold (remove air filter)	Inlet valve
Exhaust manifold	Exhaust valve
Engine oil filler neck	Pistons, piston rings
Cooling water filler neck (air bubbles)	Cylinder head gasket

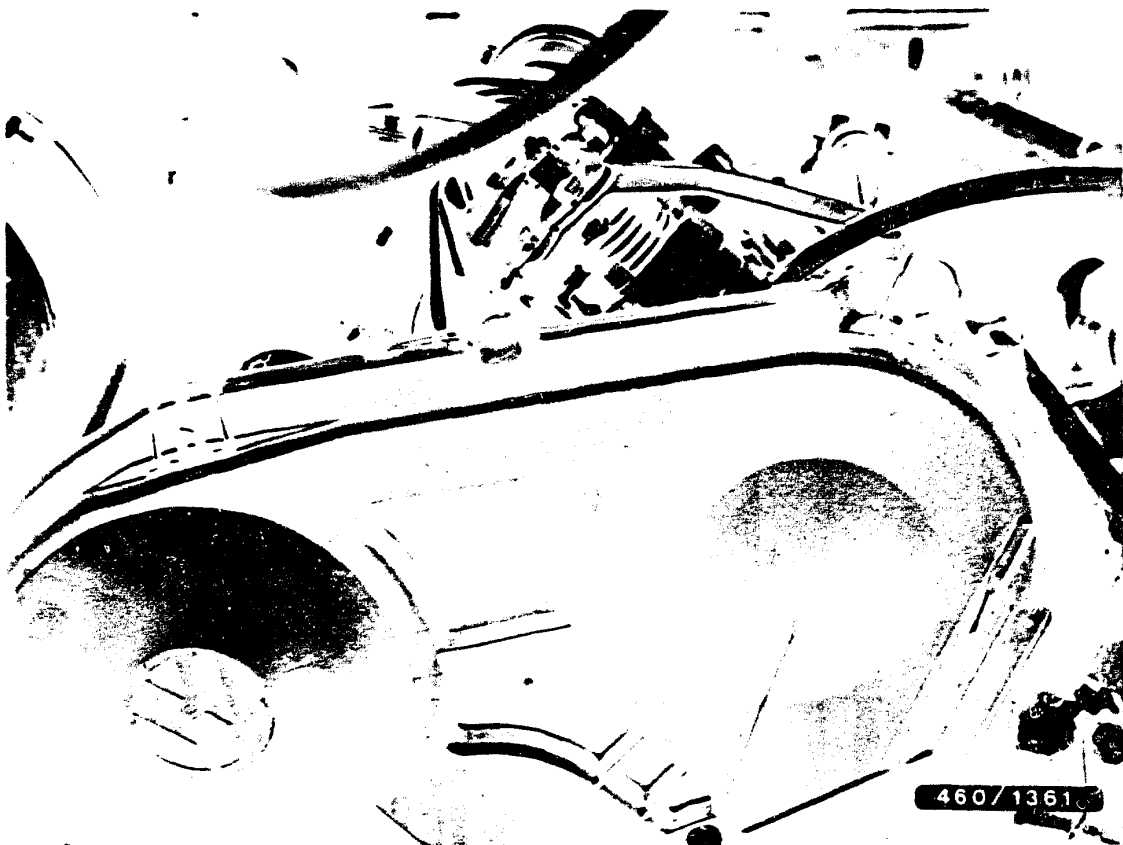
To locate the source of the fault even more accurately, pour approx. 2...3 cm³ of engine oil into the cylinder.

Repeat test.

If the compression loss is noticeably lower during this test, the fault lies with the piston or the piston rings.

In the case of new engines which have not yet been broken in (less than 5000 km), higher compression losses are possible than after the breaking-in period.





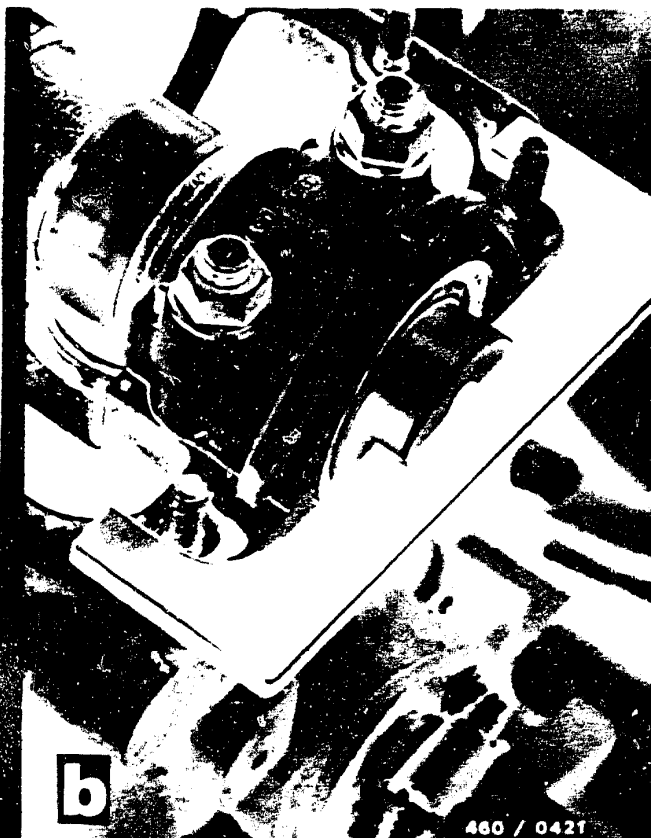
25. Removing injection pump

Disconnect negative cable at battery.

Remove toothed belt guard and cylinder head.

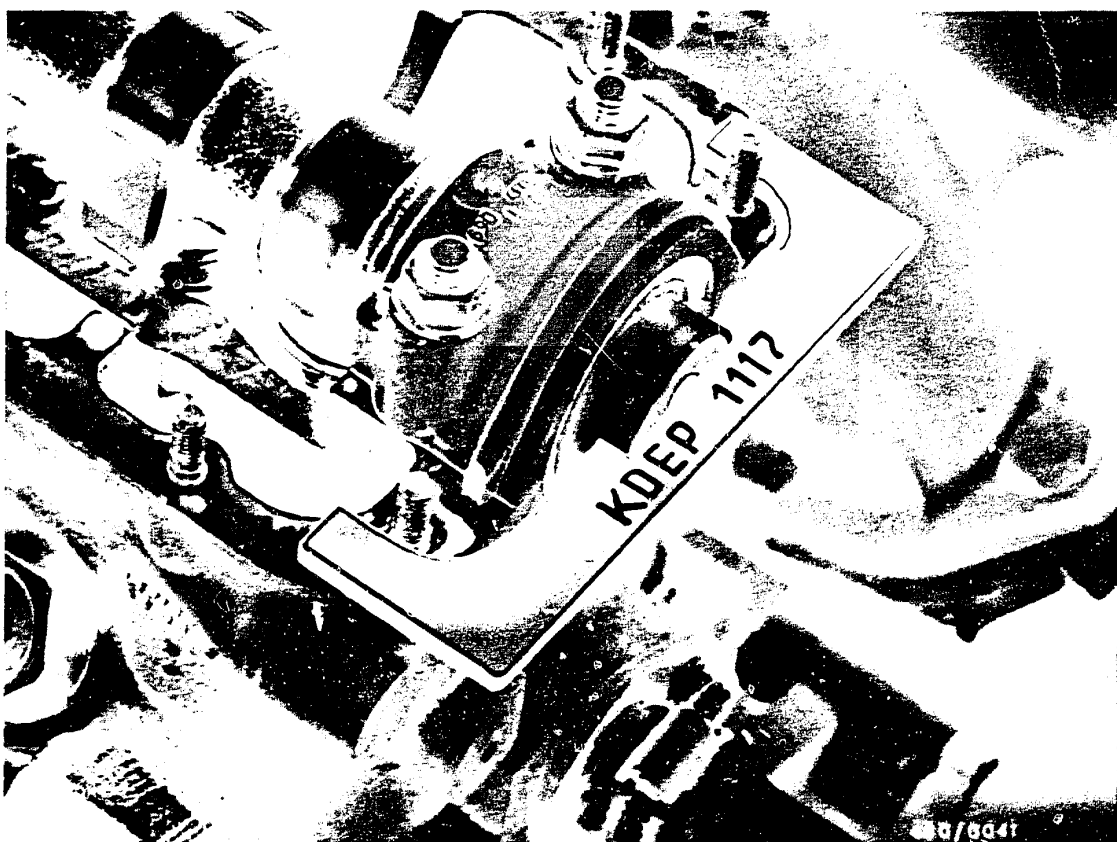
Remove air filter.





Rotate crankshaft until TDC mark (1st cylinder) on flywheel is aligned with mating mark (see arrow in Fig. a).

Lock camshaft with KDEP 1117 setting straightedge and center straightedge as follows (Fig. b).



Rotate locked camshaft until end of the setting straightedge touches cylinder head.

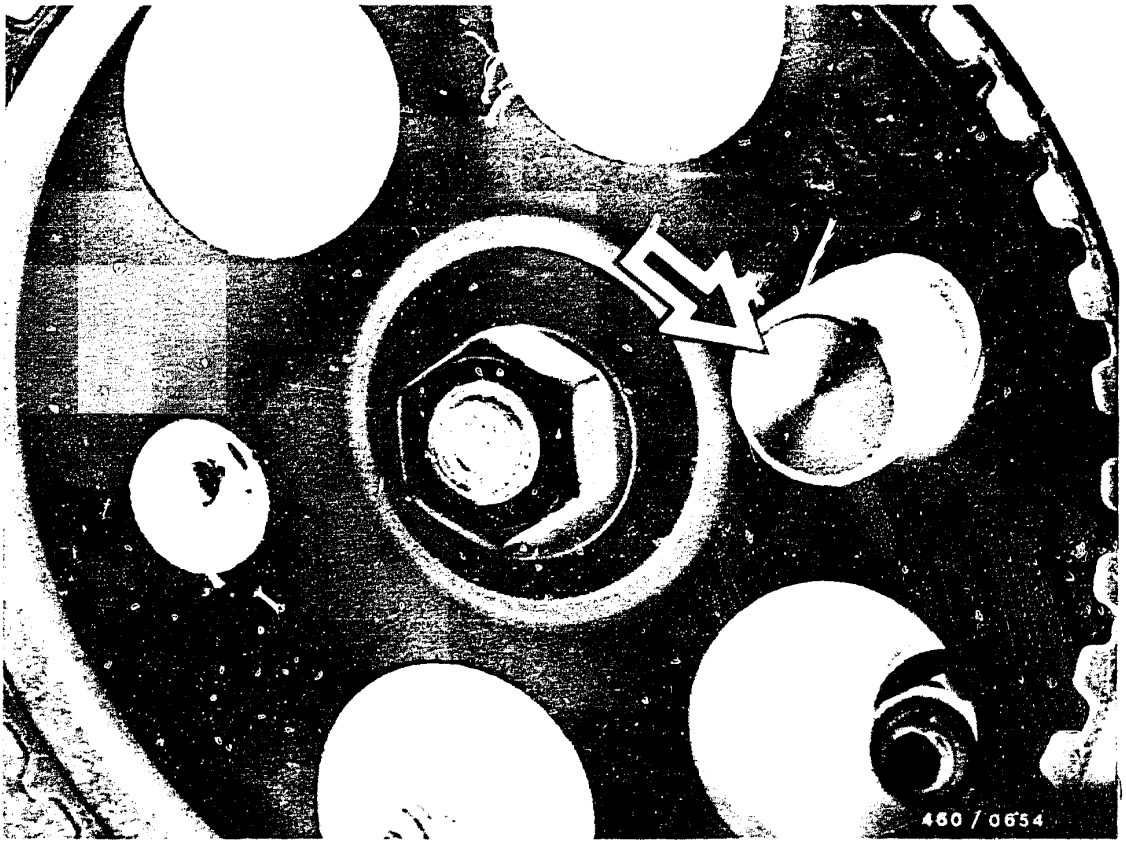
Measure resulting clearance at other end of straightedge with a feeler gauge.

Divide clearance in half and insert feeler gauge of this thickness between straightedge and cylinder head.

Now rotate camshaft so that straightedge rests against feeler gauge.

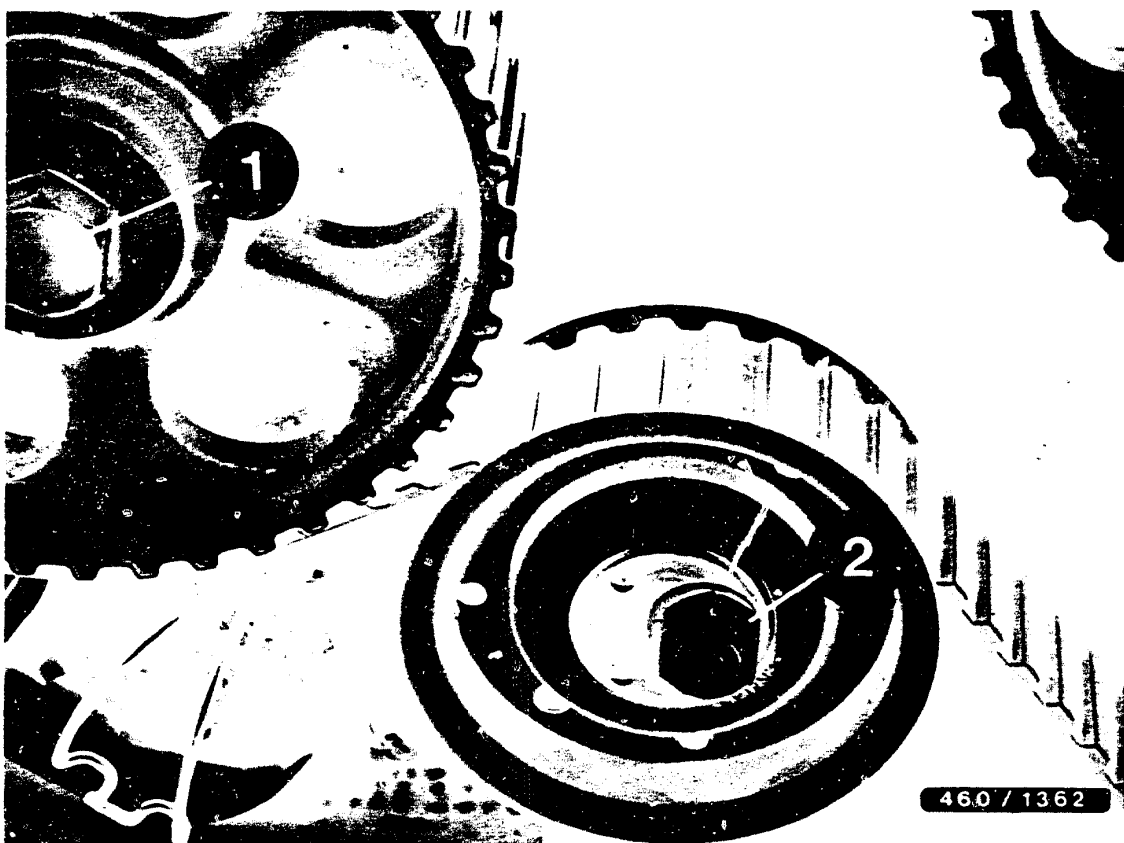
Insert second feeler gauge of same thickness at other end between straightedge and cylinder head.





Lock injection-pump gear with setting mandrel KDEP 1122 (arrow).

Loosen injection-pump gear fastening nut by 2 turns.



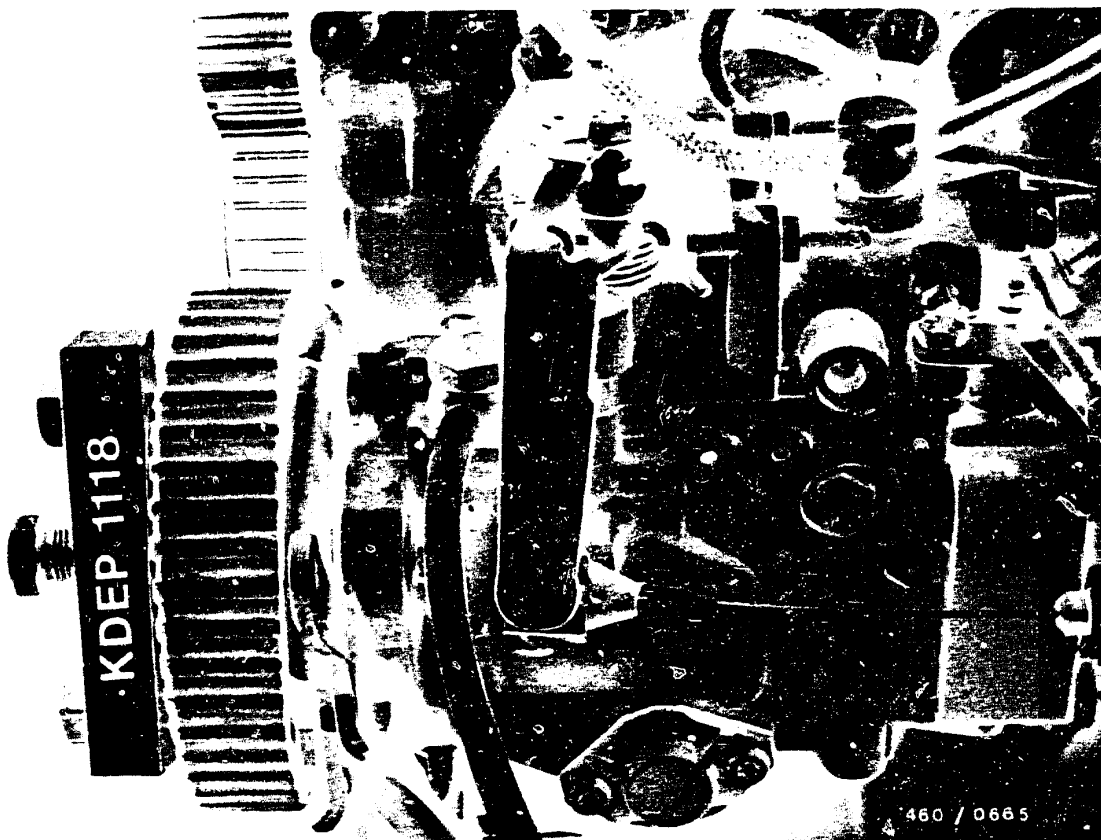
- 1 = Camshaft gear
- 2 = Belt tensioning roller

Loosen camshaft gear fastening screw by 1/2 turn and loosen camshaft gear from cone by blow with rubber hammer.

Loosen belt tensioning roller fastening screw.

Remove toothed belt from camshaft gear and injection-pump gear.





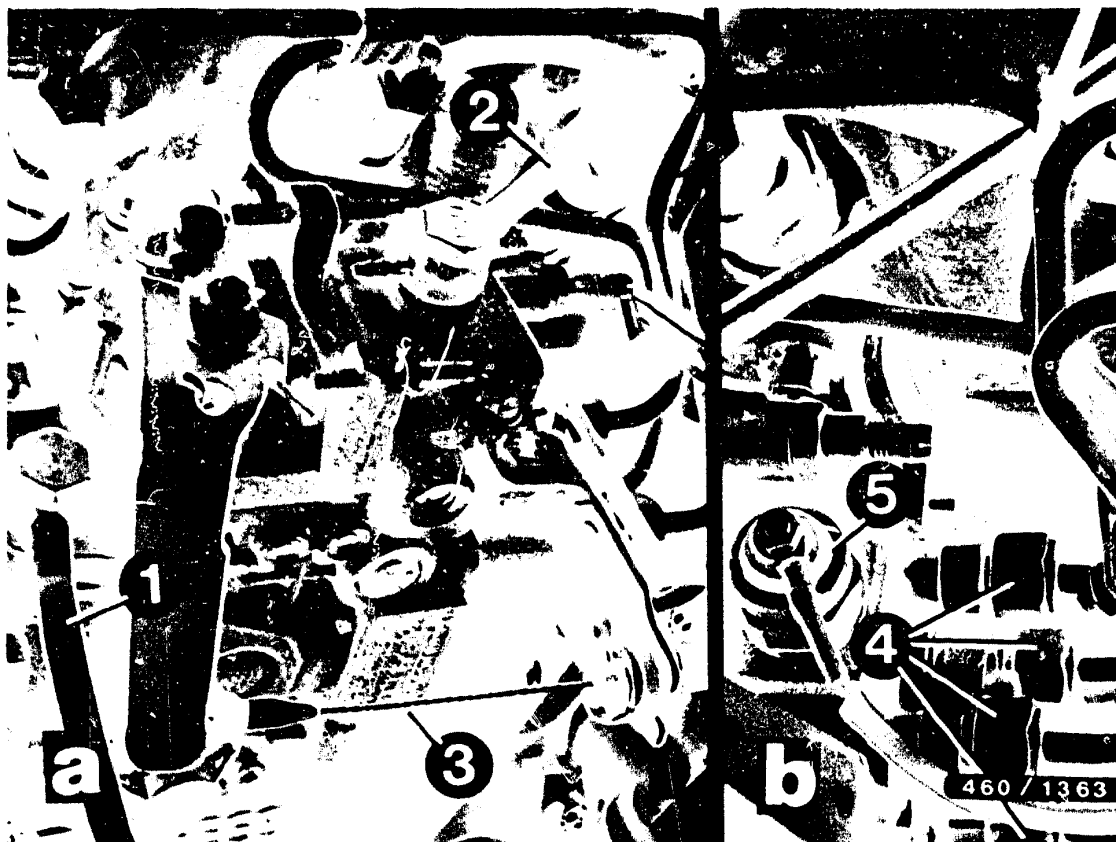
Mount puller KDEP 1118 on pump drive gear (see picture).

Loosen pump drive gear from cone of drive shaft with puller.

Remove puller KDEP 1118.

Unscrew fastening nut and take off injection-pump gear.





1 = Fuel inlet line
 2 = Fuel return line
 3 = Cable

4 = Injection lines
 5 = Shutoff device

Diesel engine

Remove fuel inlet line, return line, cable on control lever, lead for electrical shutoff device and injection lines.

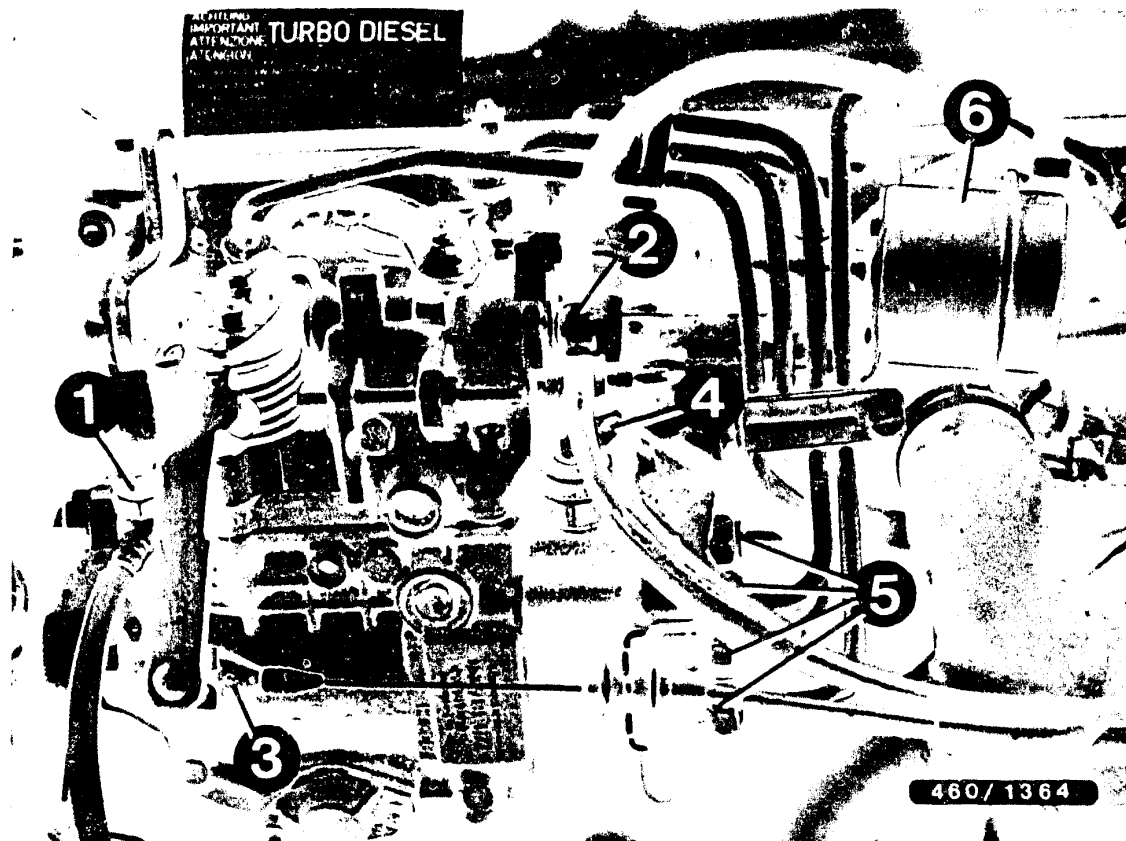
(Prevent delivery-valve holders from coming loose by holding with a wrench).

Loosen actuating cable for cold-starting aid from bearing pin and remove retainer from abutment.

E1

Remove fuel-injection pump
 VW-Transporter





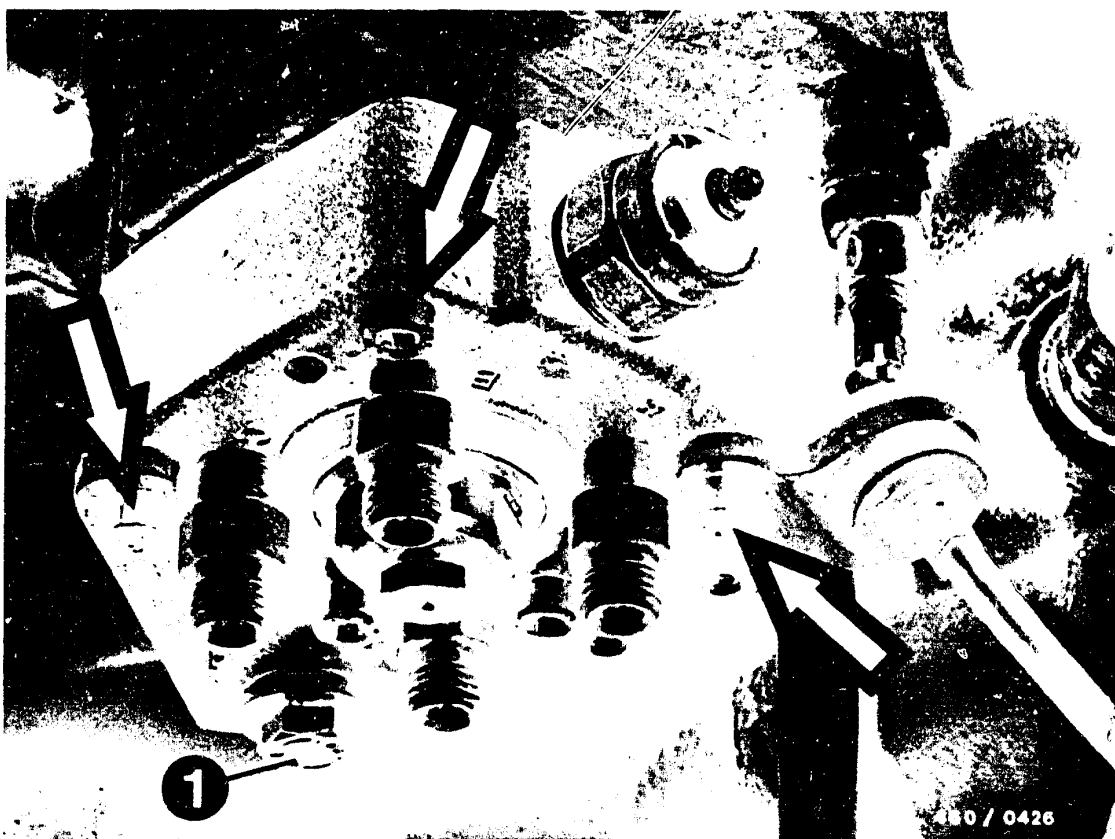
- 1 = Fuel inlet line
- 2 = Fuel return line
- 3 = Cable

- 4 = Shutoff device
- 5 = Injection line
- 6 = External manifold-pressure compensator

Turbo-diesel engine

Remove fuel inlet line, return line, cable on control lever, lead for electrical shutoff device, charge-air pressure connection and injection lines. (Prevent delivery-valve holders from coming loose by holding with a wrench).





Unscrew mounting bolt (1) from support bracket.

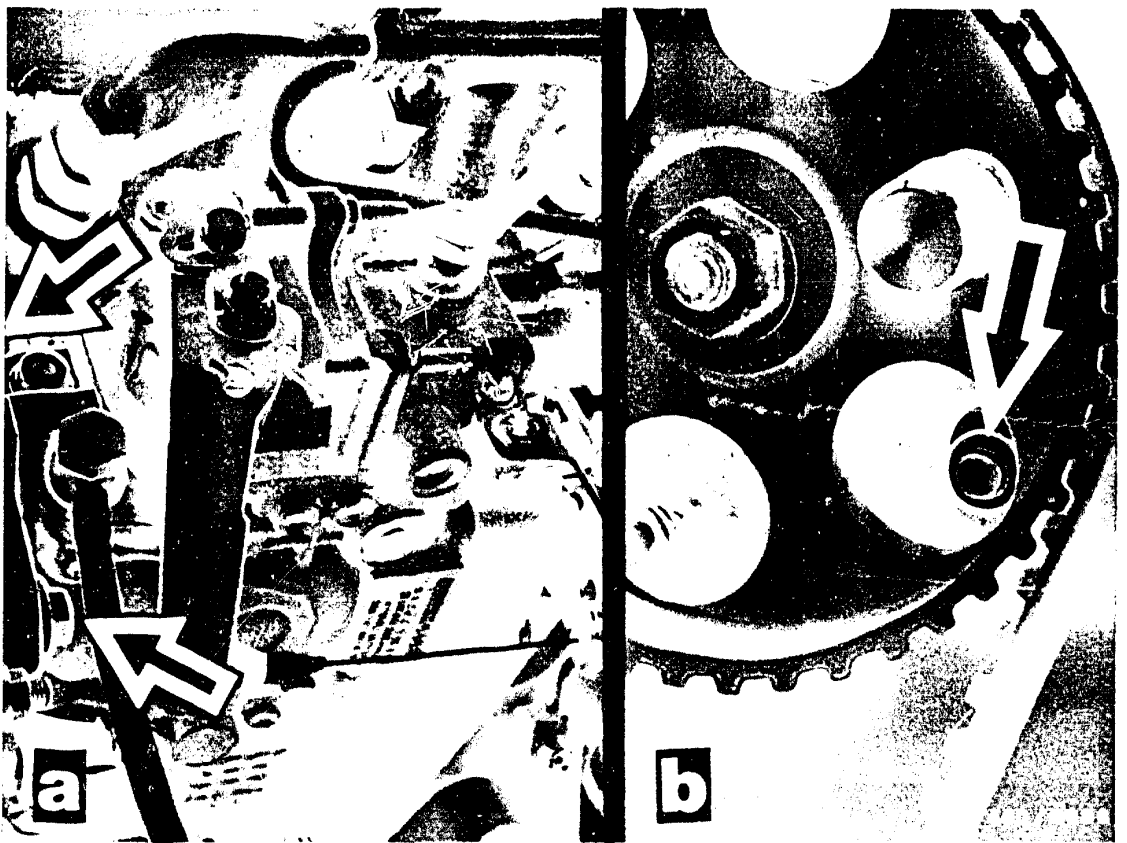
Note:

Under no circumstances loosen the distributor head mounting screws (arrows).

E3

Remove fuel-injection pump
VW-Transporter





Unscrew injection pump mounting bolts at pump flange using KDEP 1115 open-end wrench (only one bolt visible in photo).

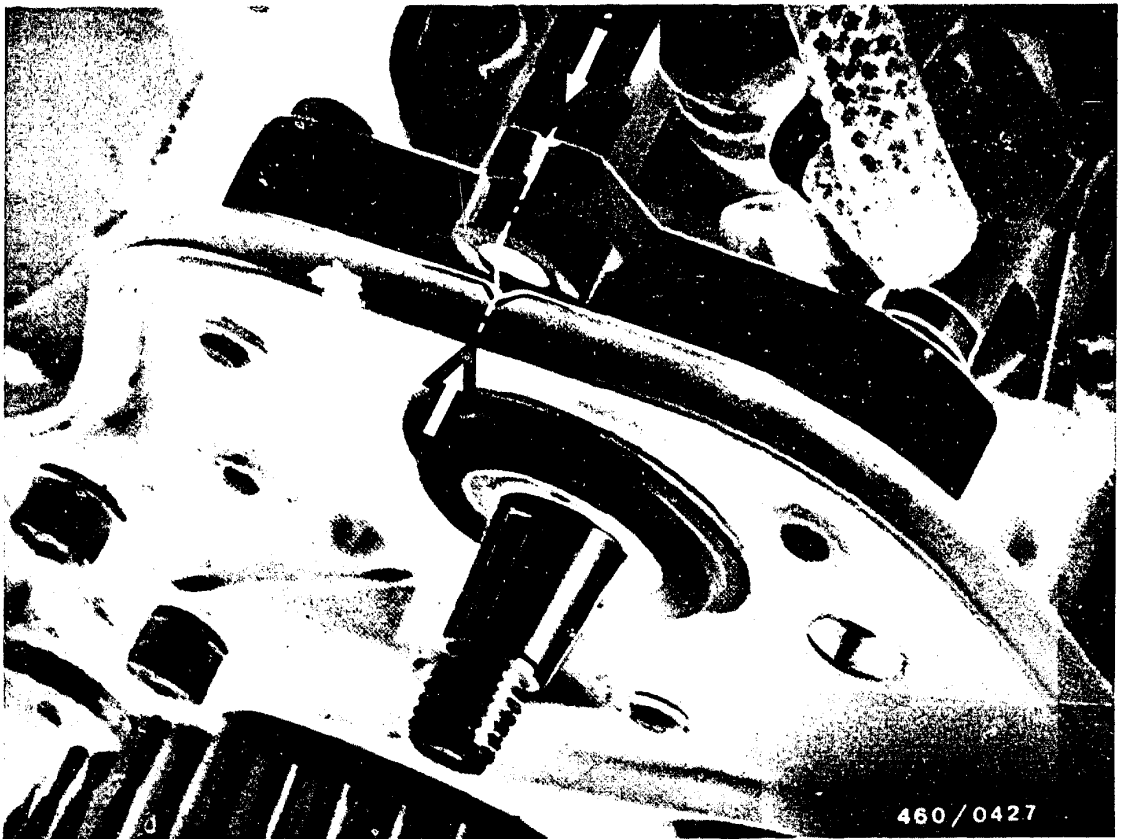
Bottom mounting bolt on bracket is screwed in from drive side (shown at arrow in Fig. b).

Lift out injection pump.

E4

Remove fuel-injection pump
VW-Transporter



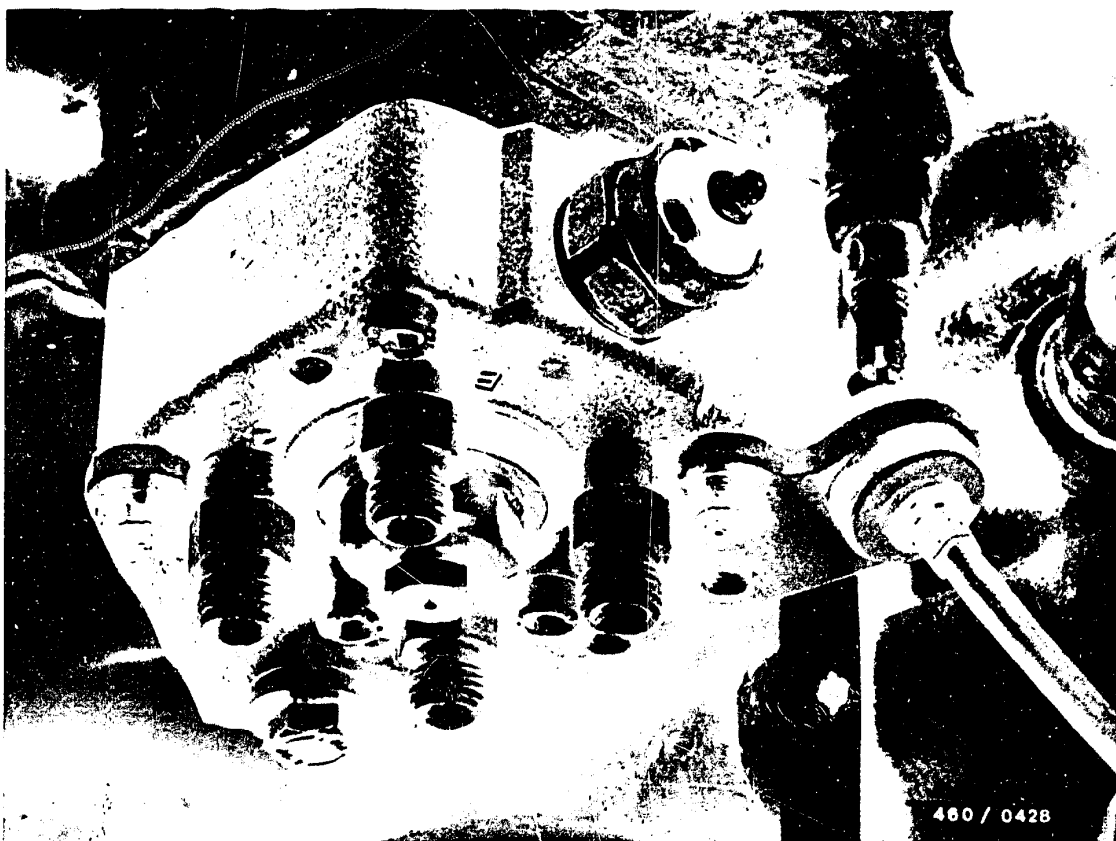


26. Installing injection pump

Install injection pump so that marks on pump and bracket match (arrow).

Replace injection pump mounting bolts and tighten with light torque.





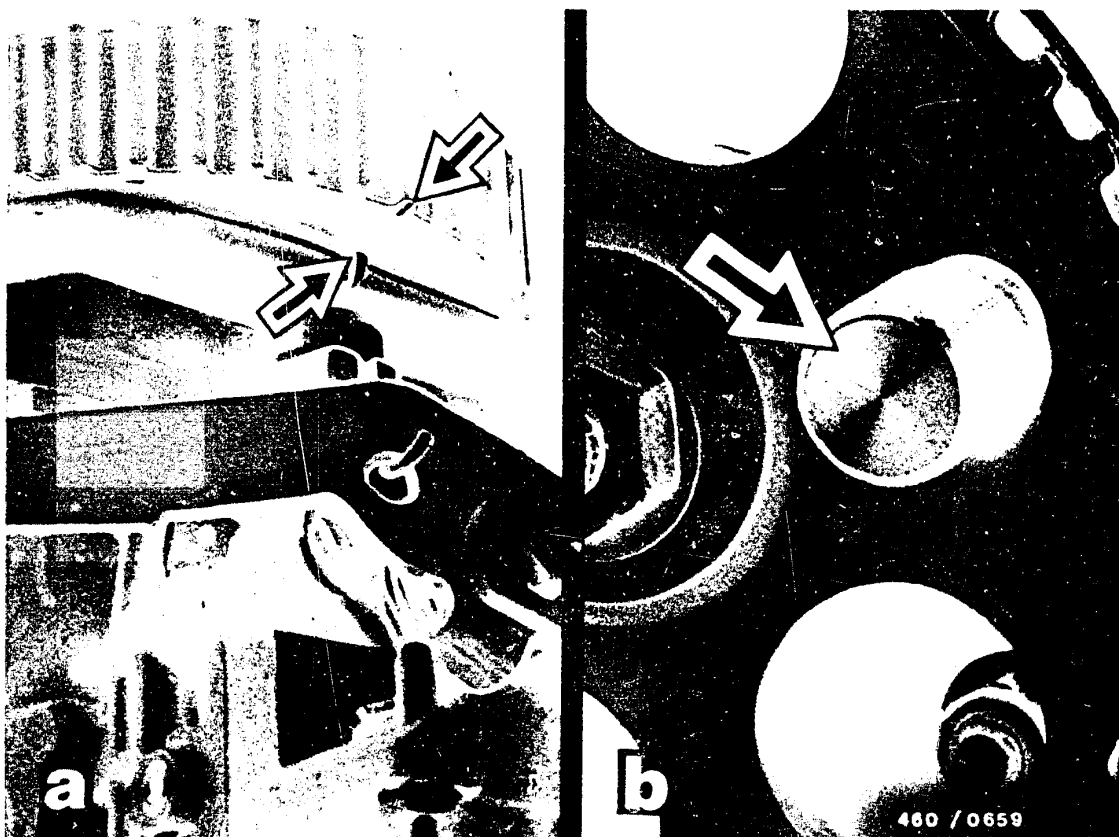
Align support bracket on injection pump distributor head so that it rests unstressed against cylinder block and distributor head.

Screw down support bracket on cylinder block.

E6

Install fuel-injection pump
VW-Transporter

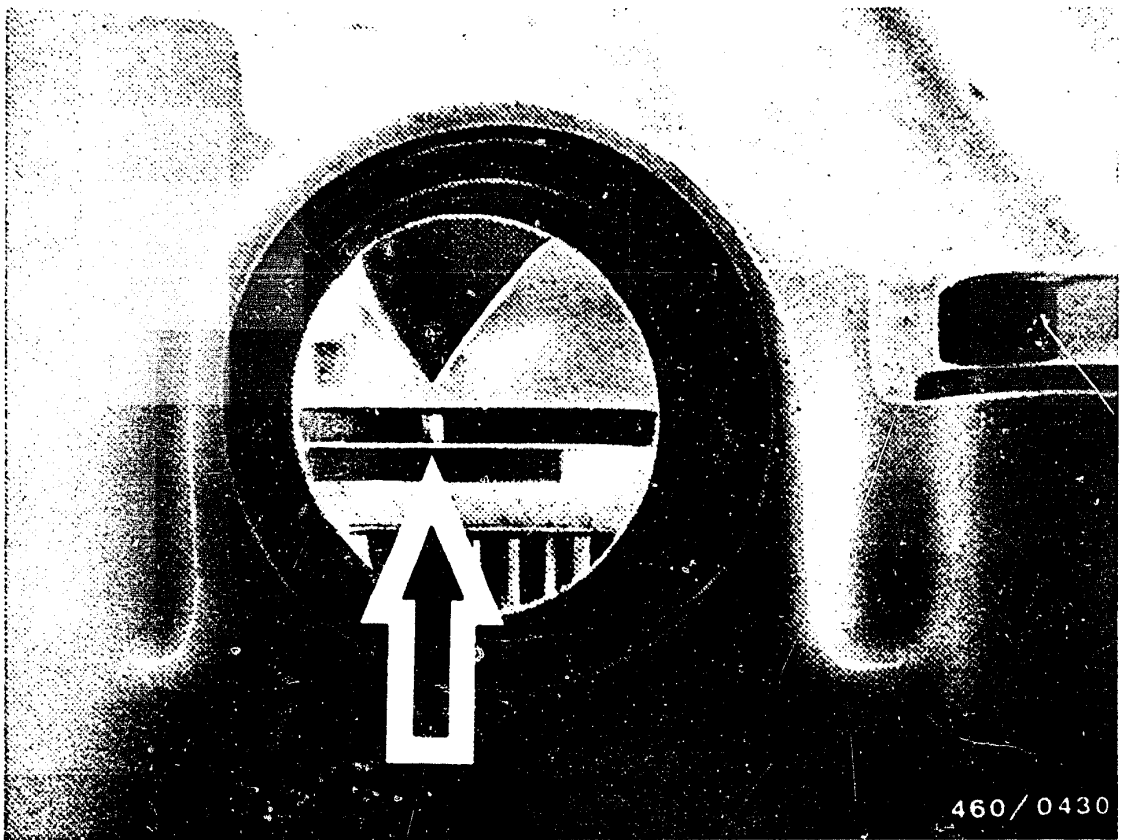




Insert Woodruff key into cone of drive shaft. Mount injection-pump gear and turn so that the marks on injection-pump gear and bracket are in alignment (picture a - arrows).

Secure injection pump sprocket using KDEP 1122 securing pin (shown at arrow in Fig. b).

Tighten mounting nut to 45 Nm.



Make sure TDC mark (cylinder 1) on flywheel is aligned with mating mark (arrow).

E8

Install fuel-injection pump
VW-Transporter





1 = Camshaft gear

2 = Toothed-belt tensioning
roller

Put on toothed belt and tension by turning the
tensioning roller.

Tighten fastening nut to 45 Nm.

Tighten camshaft-gear fastening screw only so far
that the camshaft gear can still be moved by hand.





Remove setting mandrel KDEP 1122.

Check tension of toothed belt using KDEP 1121 belt tension checker:

Turn vernier sleeve until bottom sleeve edge coincides with marking on feeler.

Read off measurement: set value = scale value 12 - 13

E10

Install fuel-injection pump
VW-Transporter





If the measured dimension deviates from the specification, re-tension toothed belt to specification at tensioning roller (arrow).

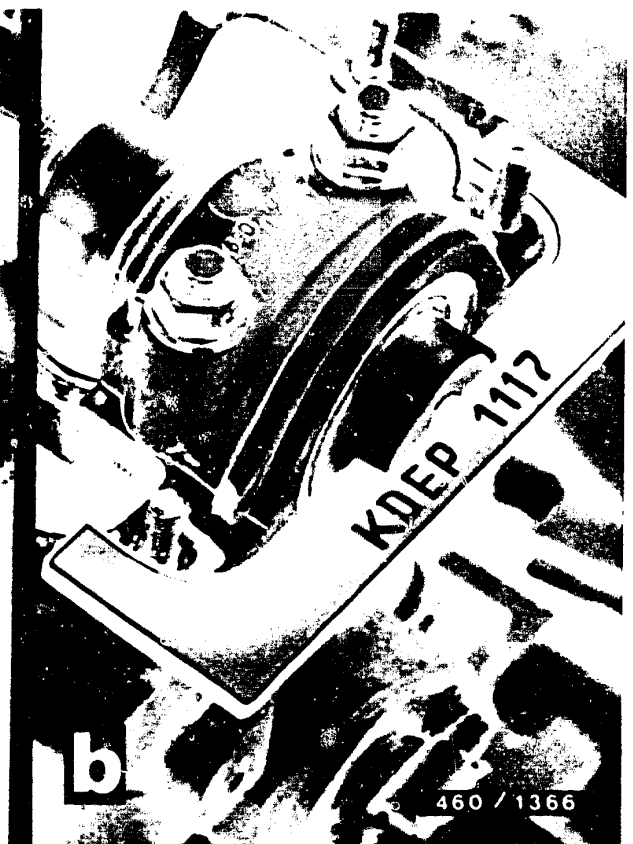
Note:

Use tensioning tool e.g. Hazet 2587.

E11

Install fuel-injection pump
VW-Transporter



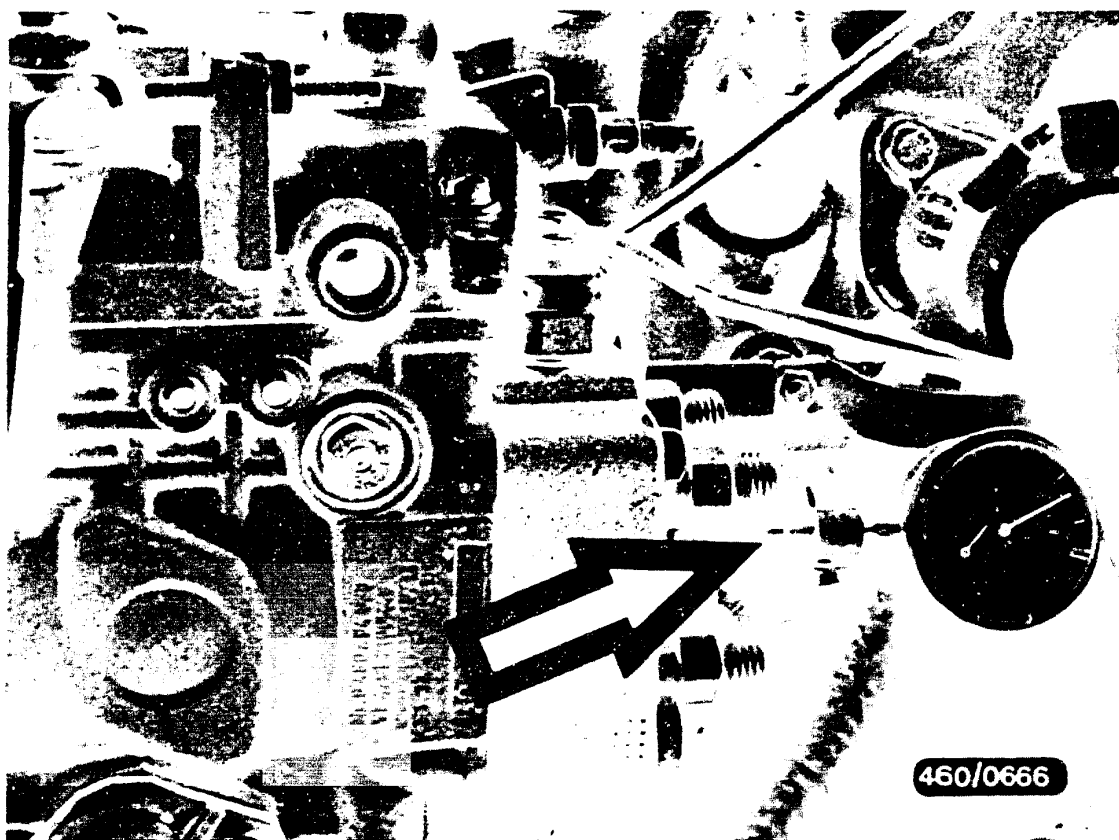


Tighten camshaft gear to 45 Nm (shown at arrow in fig.a).

Remove setting rule KDEP 1117.

Turn engine crankshaft over twice, then check tension of toothed belt again.





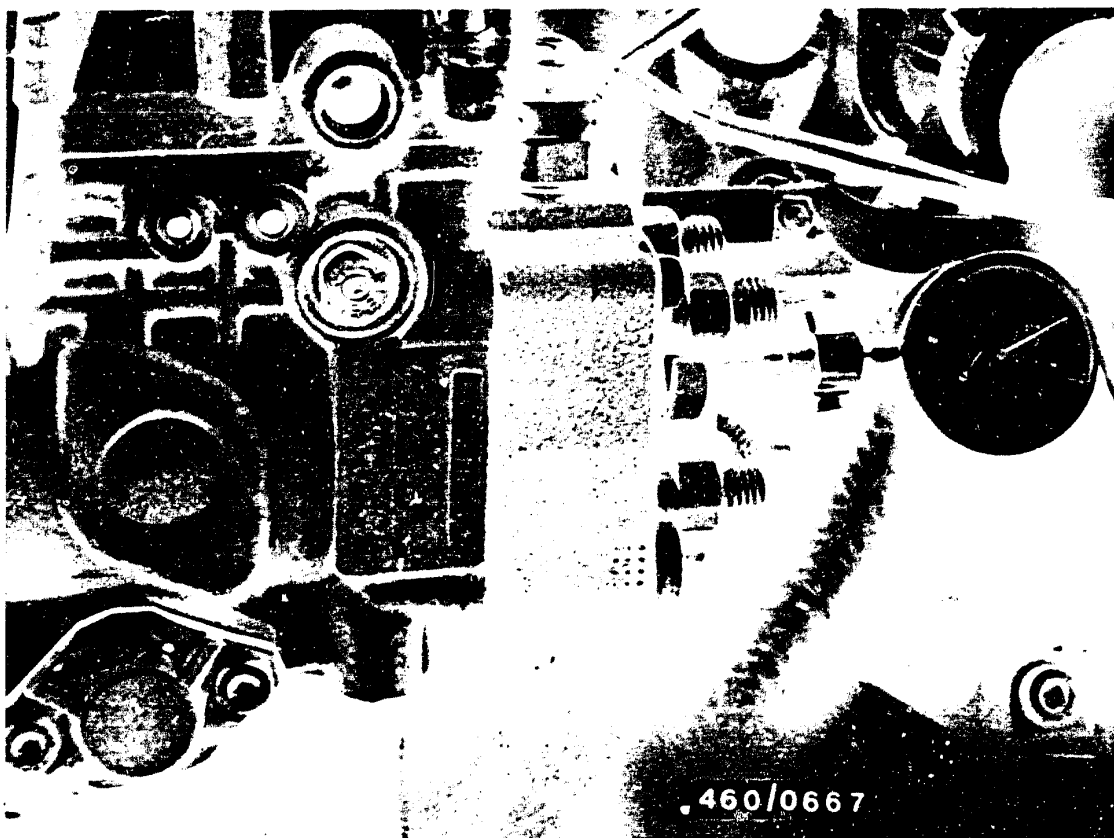
Unscrew vent screw from plug (triangle-head bolt) in center of distributor head.

Screw KDEP 1085 measuring tool (arrow) into vent screw hole.

Insert miniature dial indicator with measuring adapter into KDEP 1085 measuring tool.

Note:

Cold-start accelerator must be in zero position when checking and adjusting nominal start of pump delivery.



Preload dial indicator to approx. 2.5 mm.

Rotate crankshaft slowly against direction of engine rotation until dial indicator pointer stops moving.

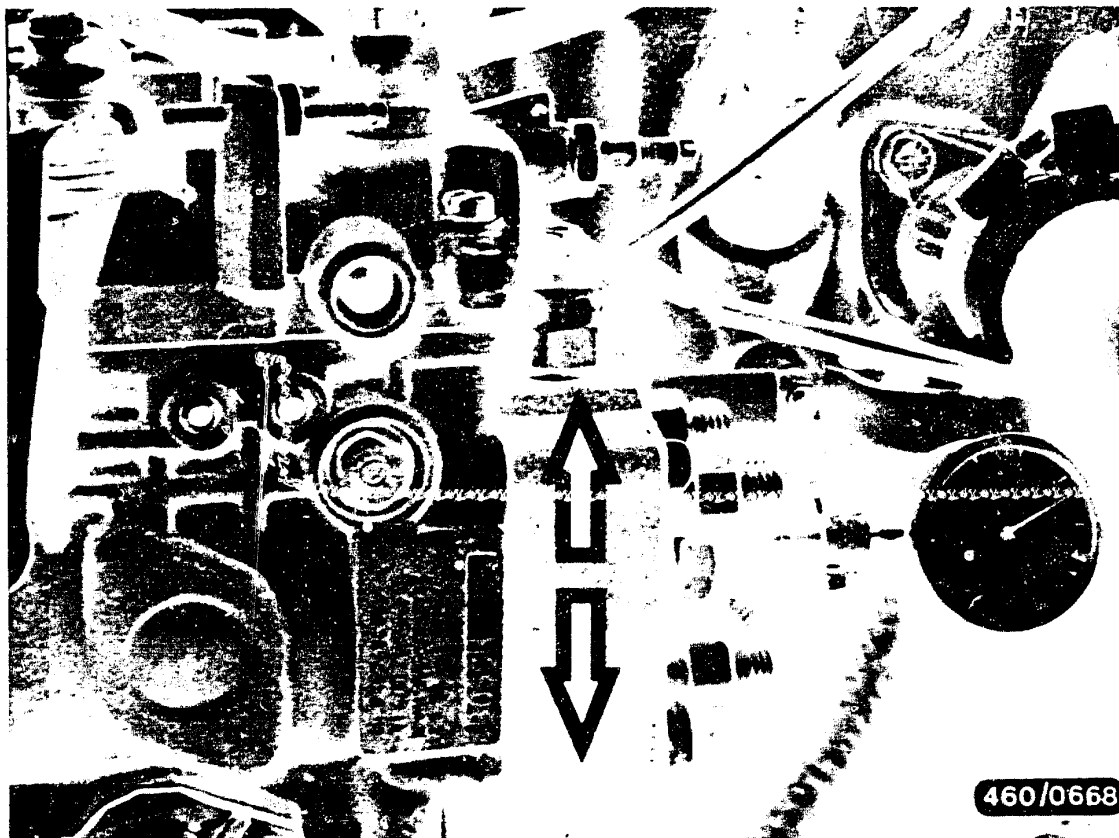
Preload dial indicator to approx. 1 mm and set to "0".

Rotate crankshaft in direction of engine rotation until TDC mark on flywheel and marks on injection pump sprocket and pump bracket coincide.

In this position, dial indicator must show following values:

Diesel and turbo-diesel engine 0.90 ± 0.02 mm ABDC.





If retiming is necessary, loosen injection pump mounting bolts and swivel pump to following stroke:

Diesel and turbo diesel 0.90 ± 0.02 mm ABDC.

Then tighten mounting bolts to 25 Nm, rotate crankshaft two revolutions and recheck setting.

Remove KDEP 1085 measuring tool and dial indicator.

Replace vent screw with new gasket.

Tighten down injection pump support bracket.





1 = Fuel inlet line
 2 = Fuel return line
 3 = Cable

4 = Injection lines
 5 = Shutoff device

Diesel engine

Mount fuel inlet line, return line, cable on control lever, lead for electrical shutoff device and injection lines.

(Prevent delivery-valve holders from turning by holding with a wrench).

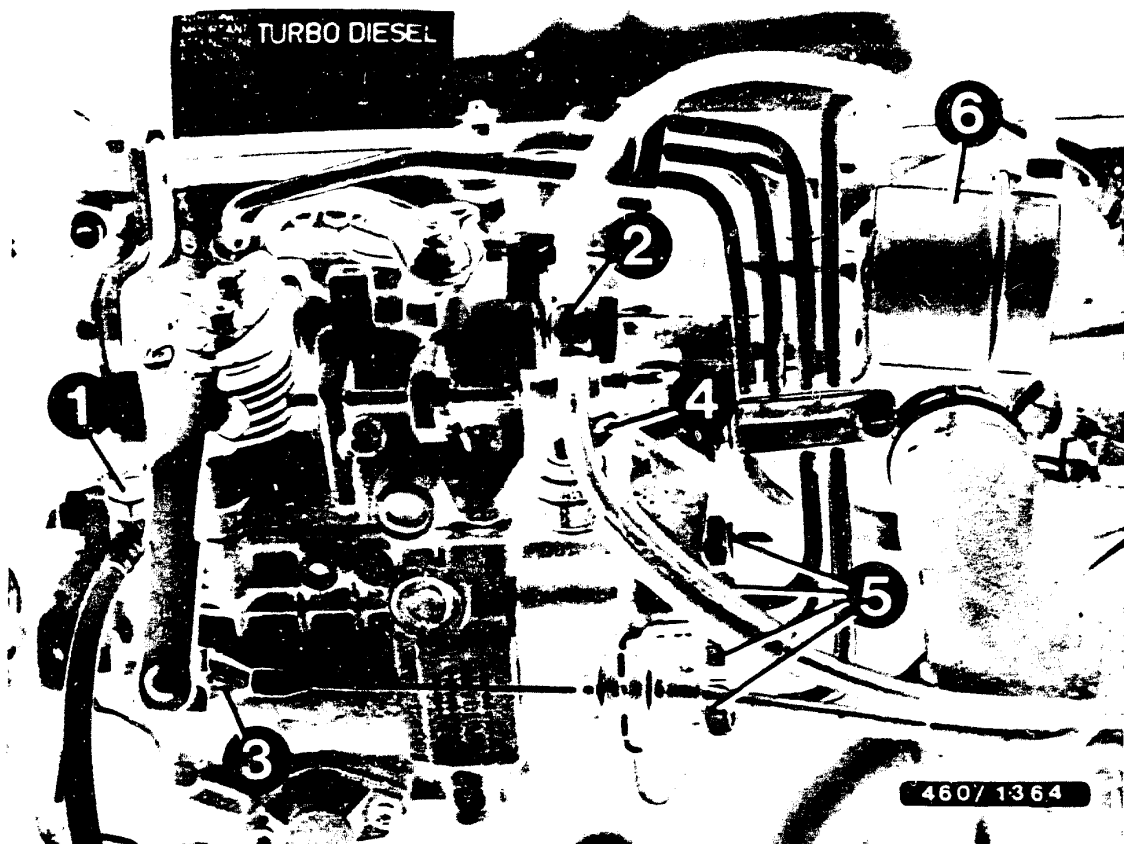
Hook in cold-start-accelerator cable.

Note:

The inlet-union screws of the fuel inlet and return lines must not be mixed up.

The inlet-union screw of the return is provided with restriction bores and the head of the screw is marked "out".





- | | |
|----------------------|--|
| 1 = Fuel inlet line | 4 = Shutoff device |
| 2 = Fuel return line | 5 = Injection lines |
| 3 = Cable | 6 = External manifold-
pressure compensator |

Turbo diesel engine

Mount fuel inlet line, return line, cable on control lever, lead for electrical shutoff device, charge-air pressure connection and injection lines.

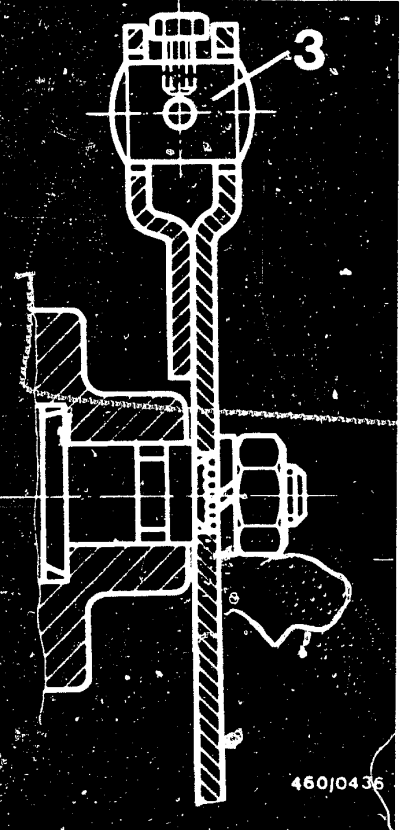
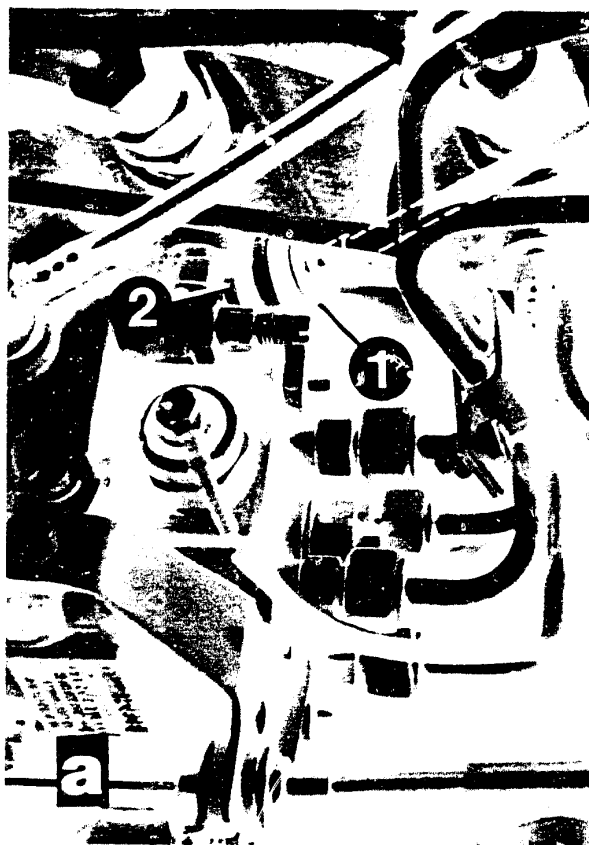
(Prevent delivery-valve holders from turning by holding with a wrench).

Note:

The inlet-union screws of the fuel inlet and return lines must not be mixed up.

The inlet-union screw of the return is provided with restriction bores and the head of the screw is marked "out".





1 = Plain washer
2 = Lock washer

3 = Bearing pin

Adjust actuating cable for cold-start accelerator

Mount cable for cold-start accelerator. Slide plain washer onto actuating cable and secure cable with lock washer.

Move stop lever to "0" position.

Pull cable taut and lock with clamp screw in bearing pin.

Reconnect negative cable at battery.



Bleeding fuel system

Fill fuel filter and injection pump with diesel fuel.

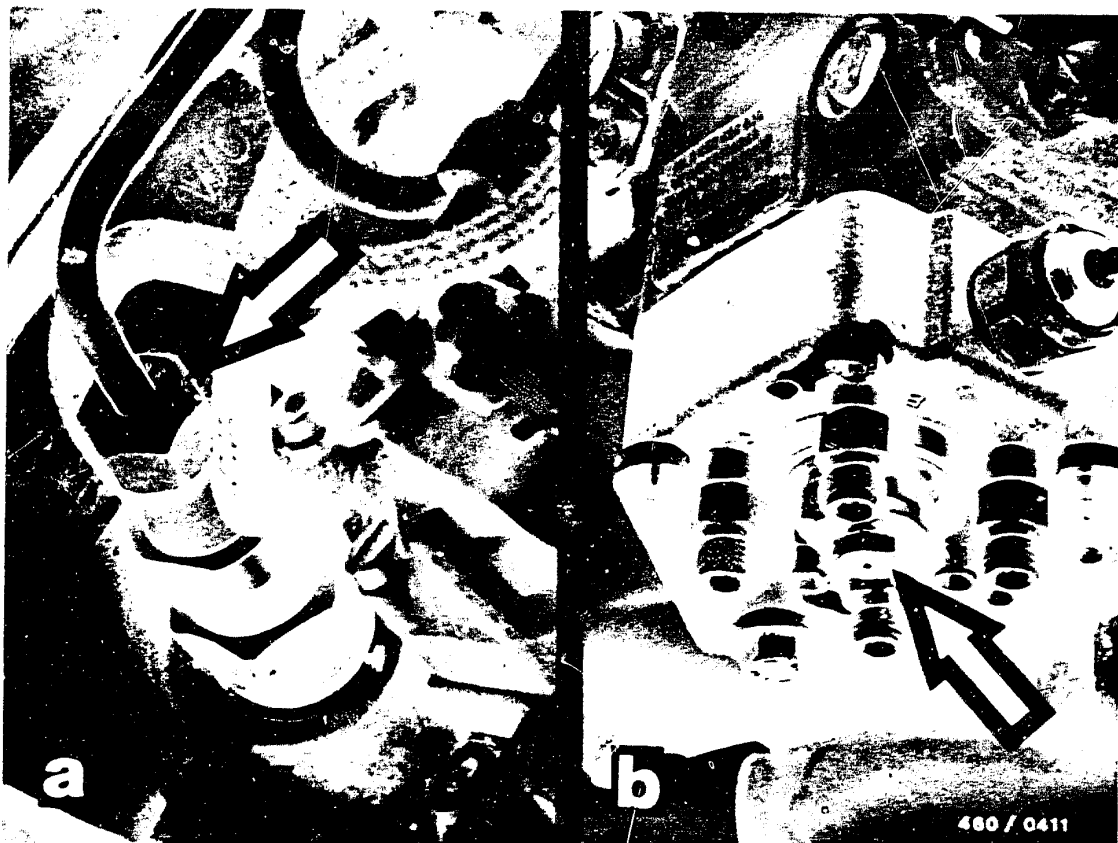
Tighten vent screw on fuel filter (shown at arrow in Fig. a).

Unscrew vent screw on injection pump several turns (shown at arrow in Fig. b).

E19

Install fuel-injection pump
VW-Transporter





Loosen delivery line union nuts on nozzle holders (shown at arrow in Fig. a).

Operate starter without pre-heating.

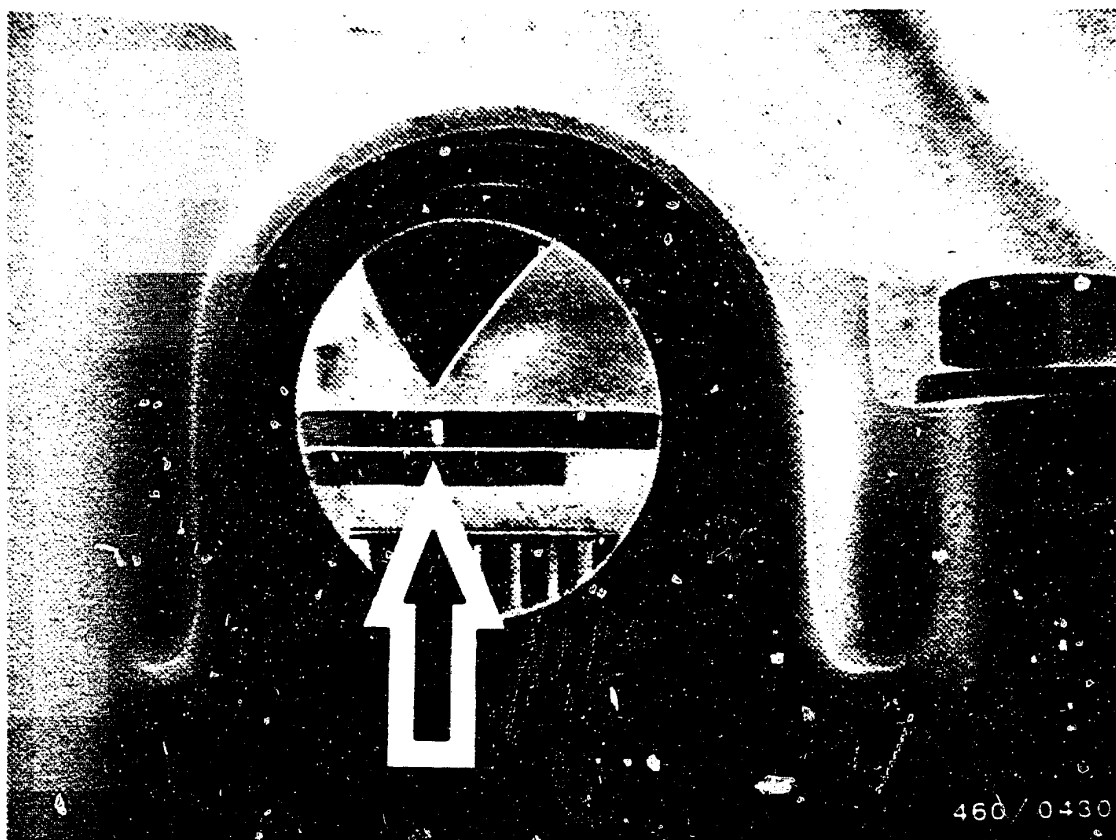
Tighten vent screw when fuel escaping through injection pump vent hole (shown at arrow in Fig. b) is free of bubbles.

Continue to operate starter until fuel escapes at nozzle holder union nuts.

Tighten union nuts.

Operate starter until engine starts.





27. Checking and adjusting engine timing

27.1 Checking engine timing

Remove cylinder head and injection pump toothed belt guard.

Rotate crankshaft until TDC mark (cylinder 1) on fly-wheel matches mating mark (shown at arrow above).

The marks on the injection pump sprocket and bracket must also coincide.

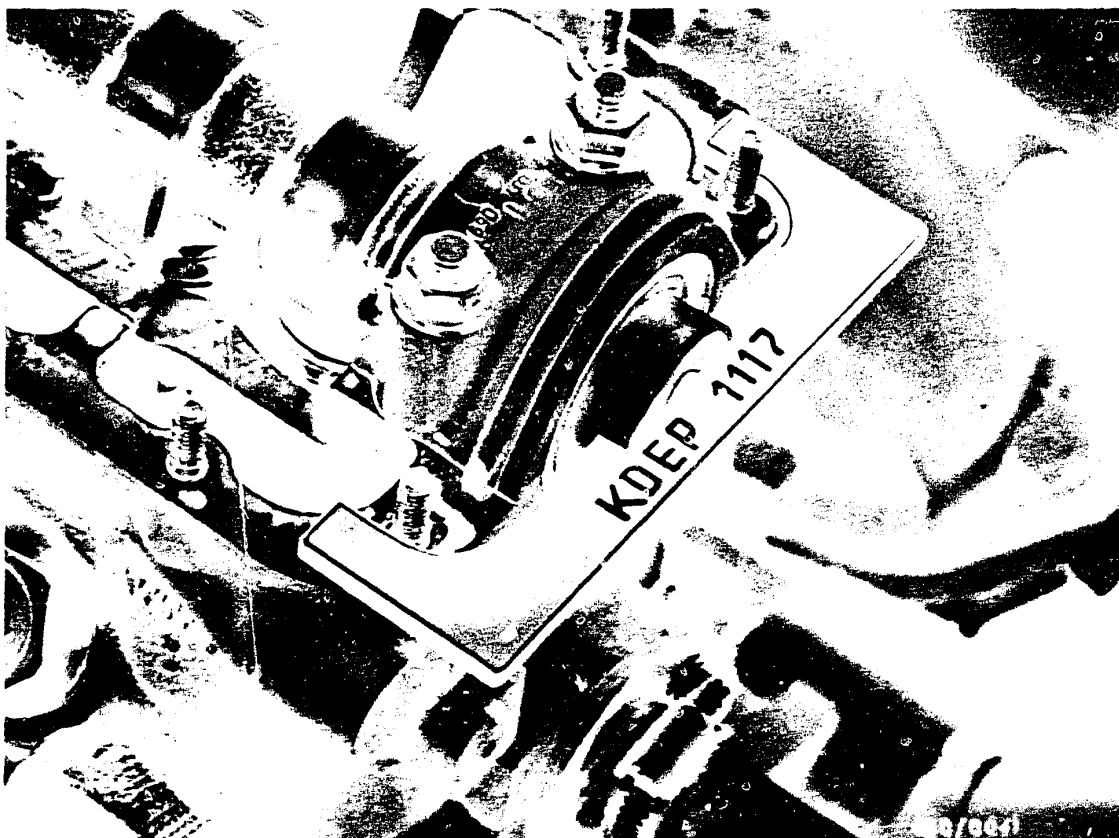




Slide KDEP 1117 setting straightedge into slot in camshaft.

If straightedge will not fit, timing is incorrect.





27.2 Adjusting engine timing

Rotate crankshaft so that setting straightedge fits into slot, and align as follows:

Rotate locked camshaft so that one end of straightedge rests against cylinder head.

Measure resulting clearance at other end of straightedge with a feeler gauge.

Divide clearance in half and insert feeler gauge of this thickness between straightedge and cylinder head. Now rotate camshaft so that straightedge rests against feeler gauge.

Insert second feeler gauge of same thickness at other end between straightedge and cylinder head.



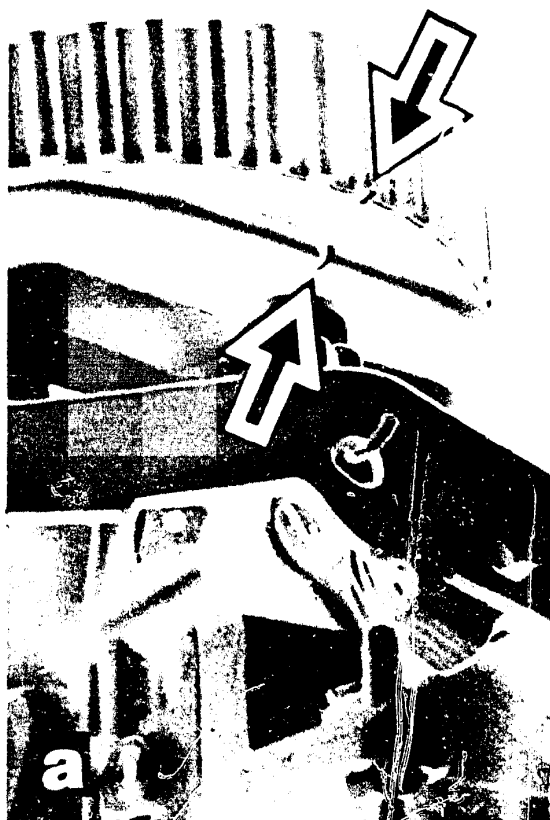


- 1 = Camshaft gear
2 = Belt tensioning roller

Loosen camshaft gear fastening screw by 1/2 turn and loosen camshaft gear from cone by blow with rubber hammer.

Loosen belt tensioning roller fastening screw.

Remove toothed belt from camshaft gear and injection-pump gear.



Rotate crankshaft until TDC mark (cylinder 1) on flywheel matches mating mark (Fig. b).

Rotate injection pump sprocket so that marks on sprocket and bracket coincide (Fig. a).

Secure injection pump sprocket with KDEP 1122 securing pin (arrow).

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Check and adjust engine timing
VW-Transporter





Put on toothed belt and tension toothed belt by turning the tensioning roller.

Tighten fastening nut to 45 Nm.

Remove KDEP 1122 securing pin.

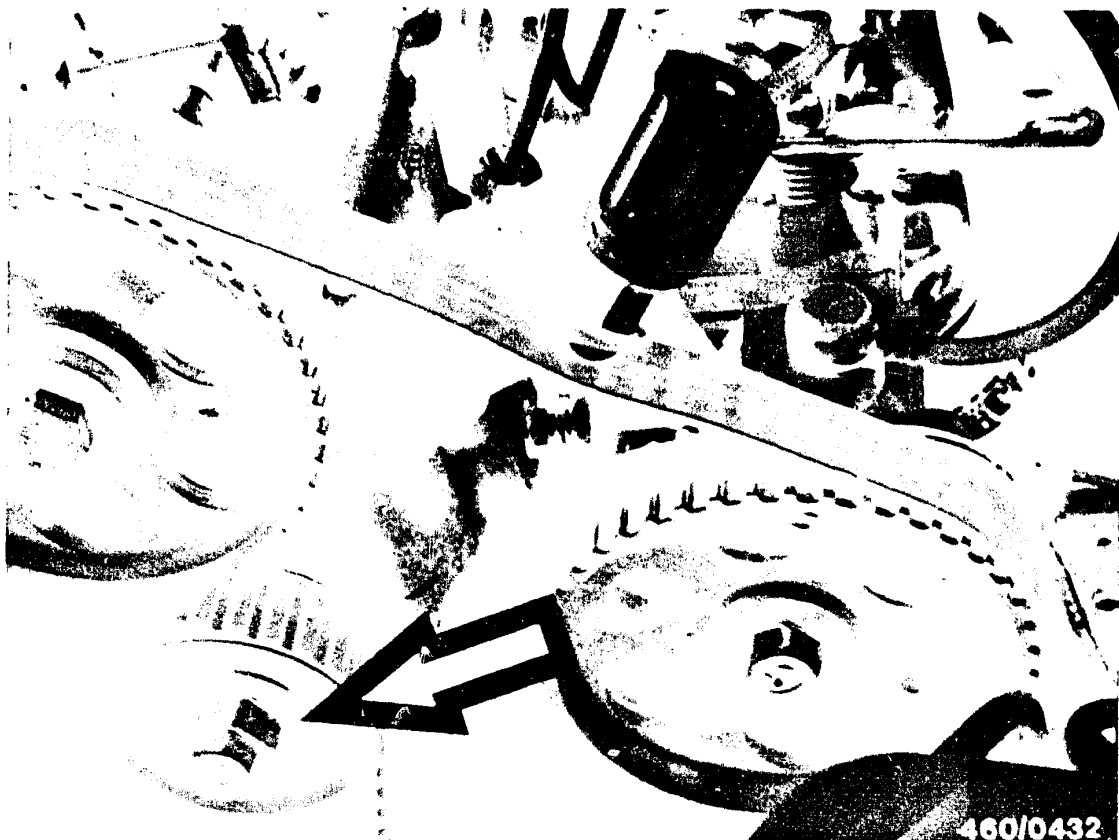
Check toothed belt tension:

Mount KDEP 1121 belt tension checker (see photo).

Turn vernier sleeve until bottom sleeve edge coincides with marking on feeler.

Read off measurement: set value = scale value 12 - 13

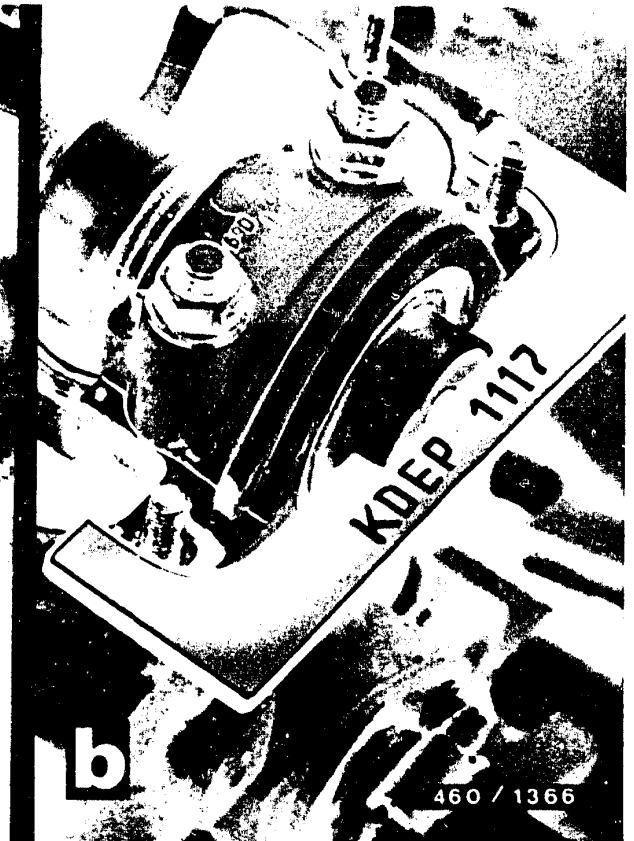




If the measured dimension deviates from the specification, re-tension toothed belt to specification at tensioning roller (arrow).

Note:

Use tensioning tool e.g. Hazet 2587.



Tighten camshaft gear to 45 Nm (shown at arrow in fig.a).

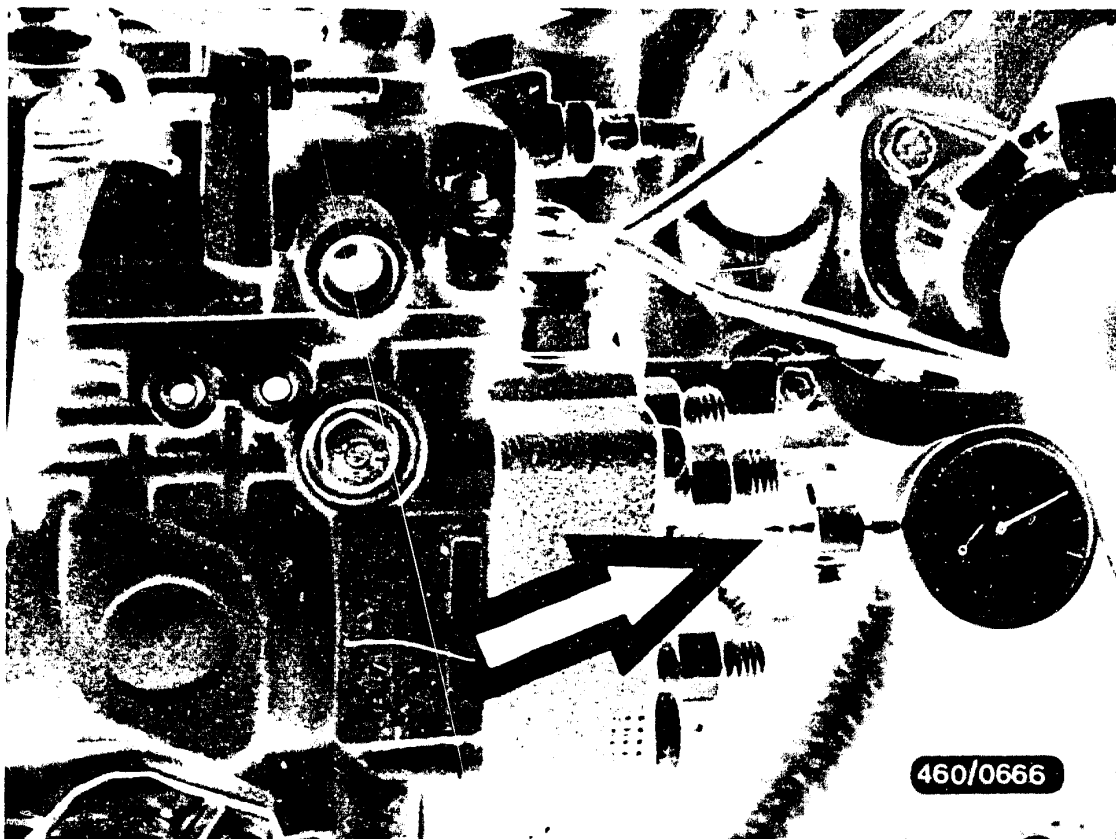
Remove setting rule KDEP 1117.

Turn engine crankshaft over twice, then check tension of toothed belt again.

Mount toothed-belt protective cover and cylinder head cover.

Mount air filter.





Remove injection lines from injection pump and from nozzle holders. (Prevent delivery-valve holders from coming loose by holding with a wrench).

Unscrew bleeder screw from central screw plug (triangular plug) on hydraulic head.

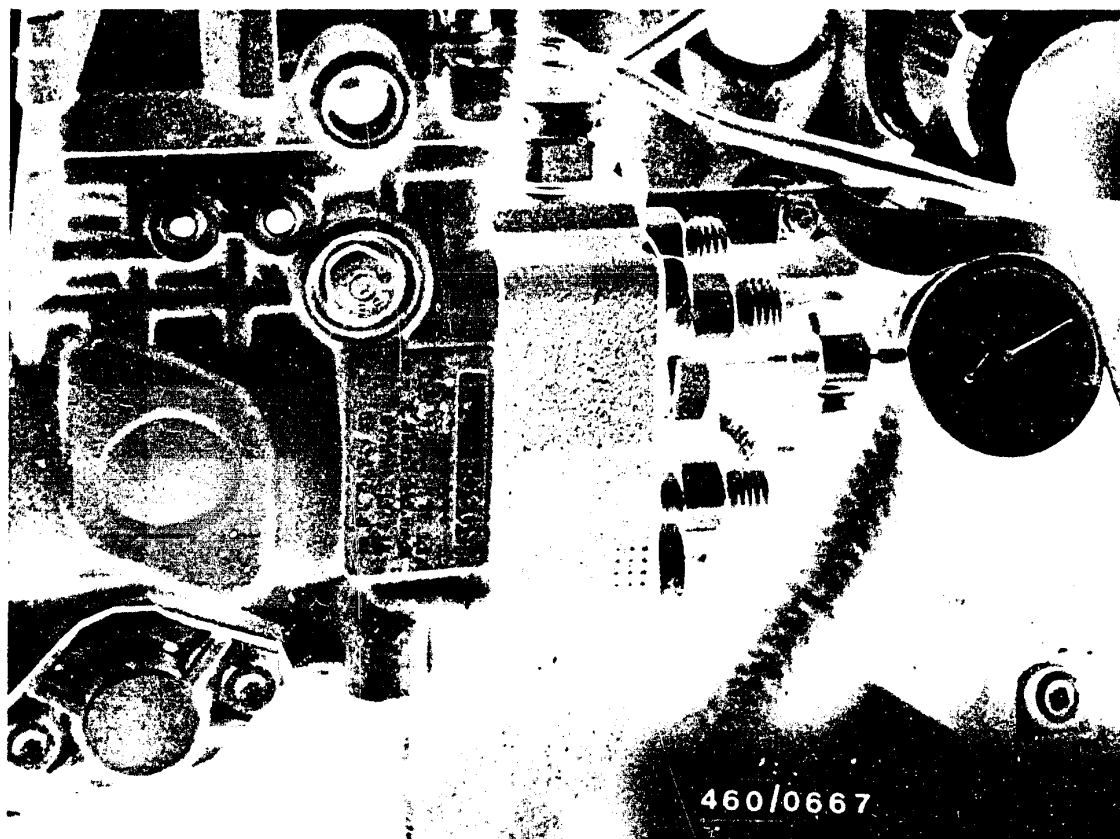
Screw KDEP 1085 measuring tool into vent screw hole (arrow).

Insert miniature dial indicator with measuring adapter into KDEP 1085 measuring tool.

Note:

Cold-start accelerator must be in zero position when checking and adjusting nominal start of pump delivery.





Preload dial indicator to approx. 2.5 mm.

Rotate crankshaft slowly against direction of engine rotation until dial indicator pointer stops moving.

Preload dial indicator to approx. 1 mm and set to "0".

Rotate crankshaft in direction of engine rotation until TDC mark on flywheel and marks on injection pump sprocket and pump bracket coincide.

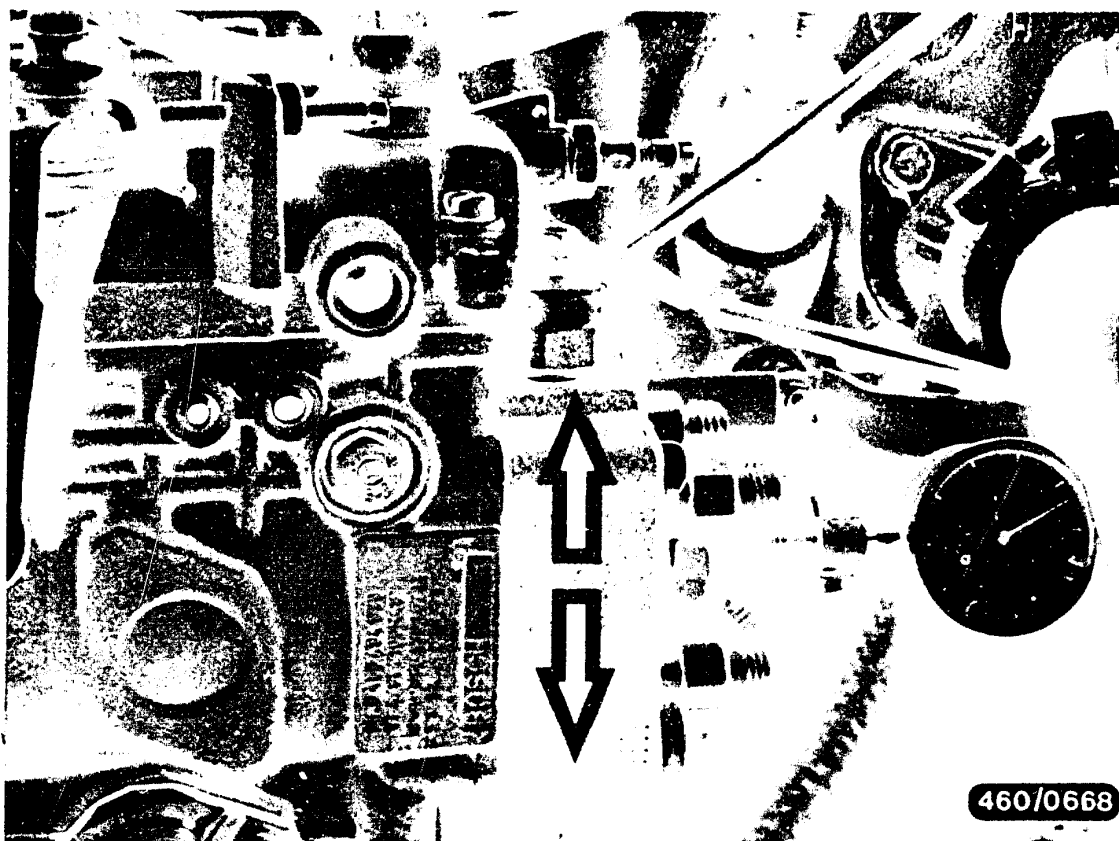
In this position, dial indicator must show following values:

Diesel and turbo-diesel engine 0.83 ... 0.97 mm ABDC.

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Check and adjust engine timing
VW-Transporter





If retiming is necessary, loosen injection pump mounting bolts and swivel pump to following stroke:

Diesel and turbo diesel 0.90 ± 0.02 mm ABDC.

Then tighten mounting bolts to 25 Nm, rotate crankshaft two revolutions and recheck setting.

Remove KDEP 1085 measuring tool and dial indicator.

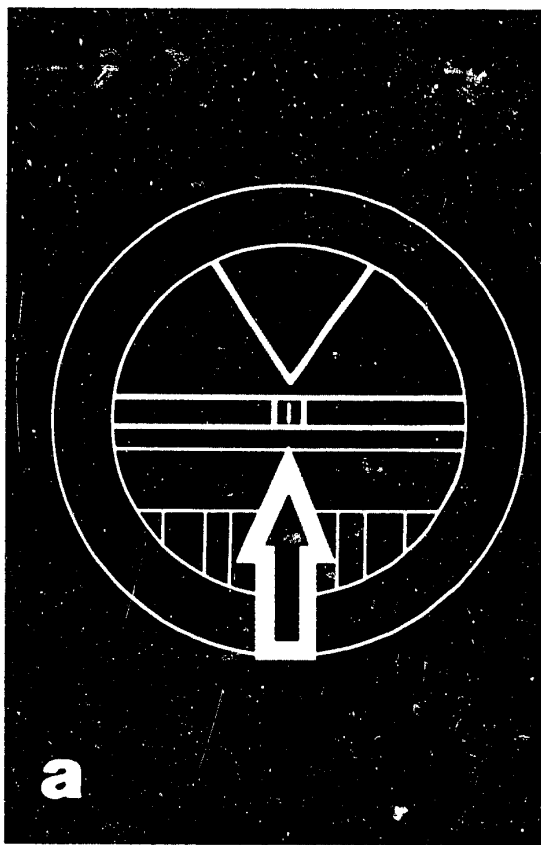
Replace vent screw with new gasket.

Tighten down injection pump support bracket.

Screw down injection lines on injection-pump delivery-valve holders and on nozzle holders.

(Prevent delivery-valve holders from turning by holding with a wrench).





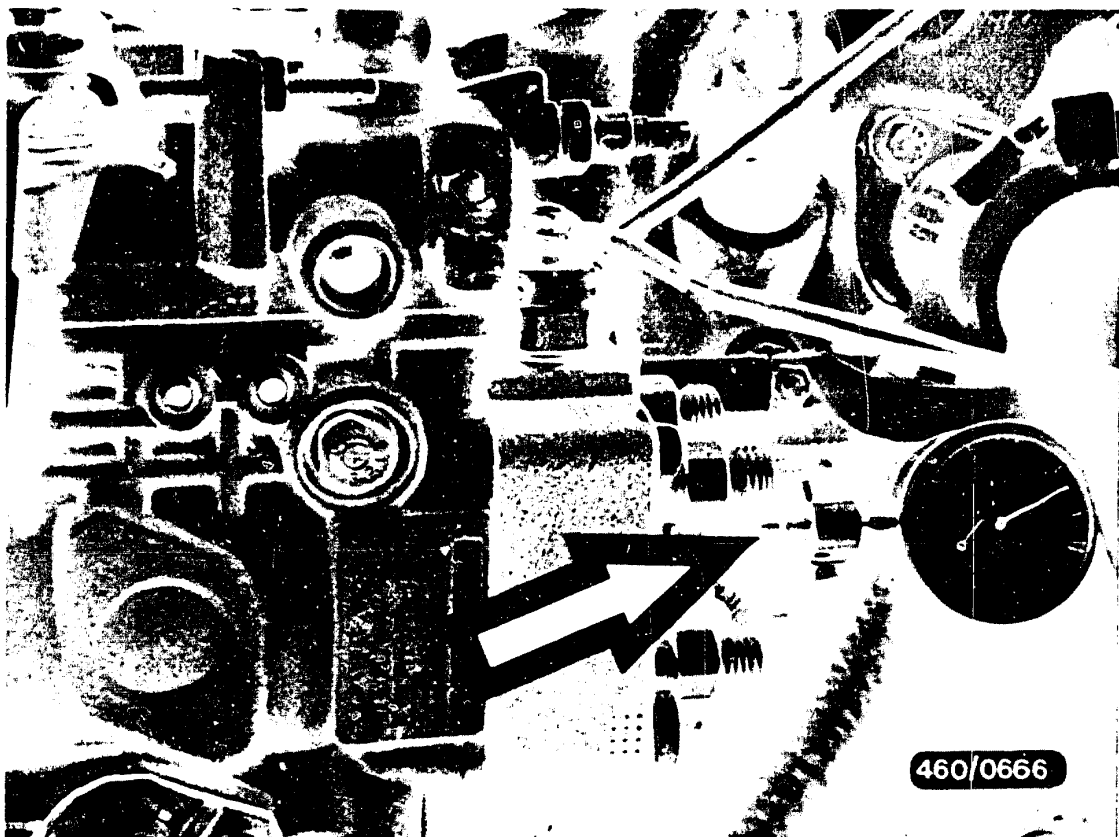
28. Injection pump/engine position agreement

Remove toothed belt guard for injection pump drive.

Rotate crankshaft until TDC mark (1st cylinder) on fly-wheel matches mating mark (Fig. b).

In this position the marks on the injection pump sprocket and bracket must coincide (Fig. a).





Remove injection lines from injection pump and from nozzle holders. (Prevent delivery-valve holders from coming loose by holding with a wrench).

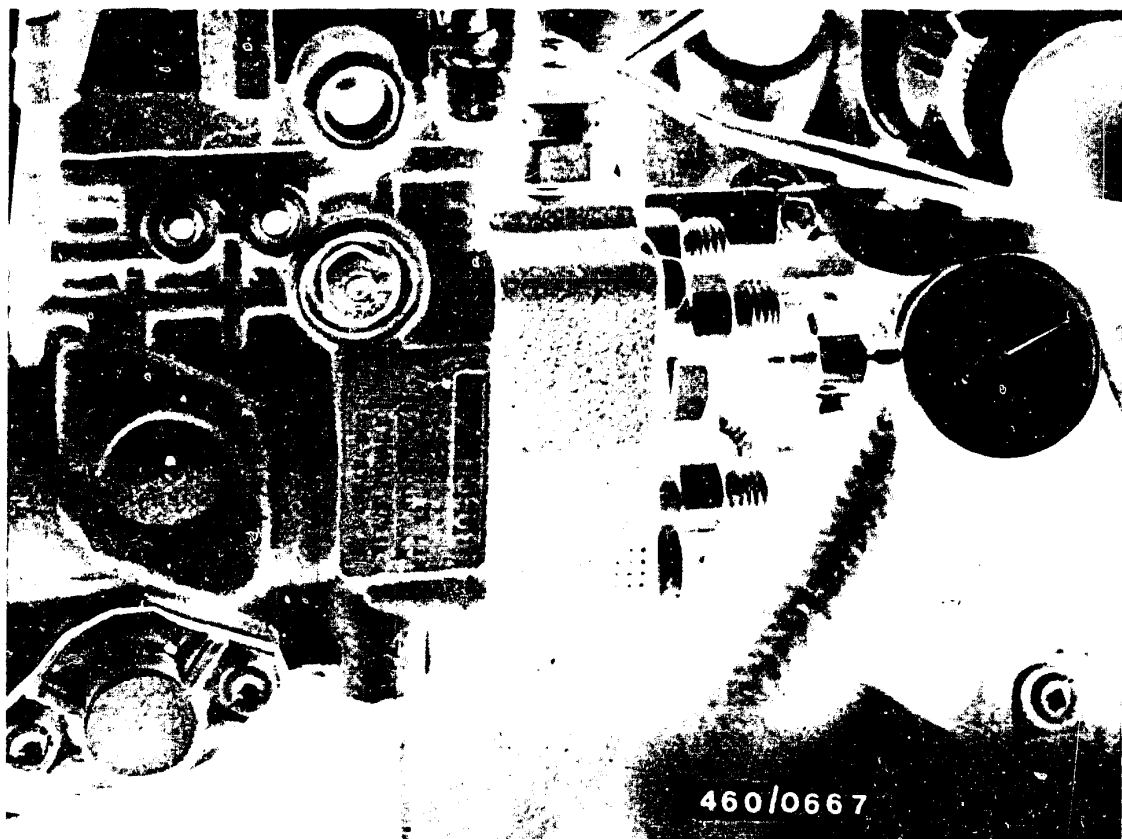
Unscrew bleeder screw from central screw plug (triangular plug) on hydraulic head.

Screw KDEP 1085 measuring tool into vent screw hole (arrow).

Insert miniature dial indicator with measuring adapter into KDEP 1085 measuring tool.

Note:

Cold-start accelerator must be in zero position when checking and adjusting nominal start of pump delivery.



Preload dial indicator to approx. 2.5 mm.

Rotate crankshaft slowly against direction of engine rotation until dial indicator pointer stops moving.

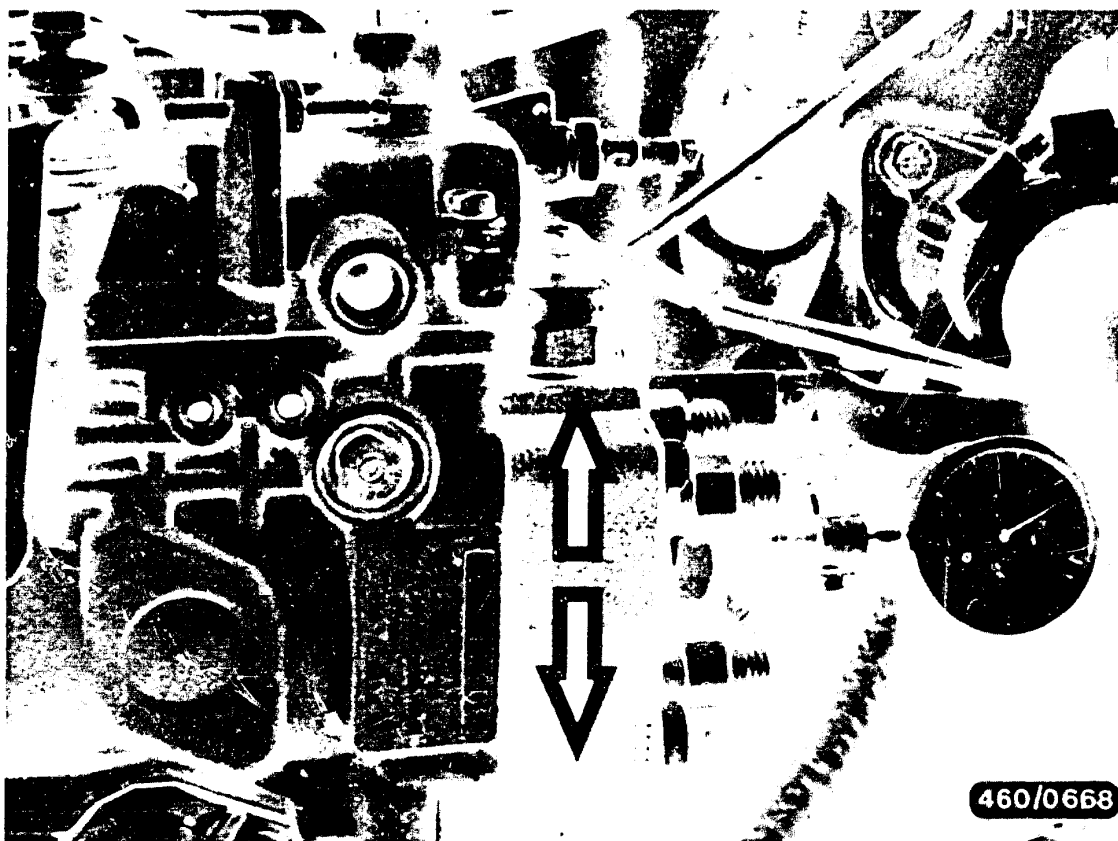
Preload dial indicator to approx. 1 mm and set to "0".

Rotate crankshaft in direction of engine rotation until TDC mark on flywheel matches mating mark.

In this position indicator must show following check values:

Diesel and turbo-diesel engine 0.83...0.97 mm ABDC.





If retiming is necessary, loosen injection pump mounting bolts and swivel pump to following stroke:

Diesel and turbo diesel 0.90 ± 0.02 mm ABDC.

Then tighten mounting bolts to 25 Nm, rotate crankshaft two revolutions and recheck setting.

Note:

The lower fastening screw on the bracket is installed from the drive end.



Remove KDEP 1085 measuring tool and dial indicator.

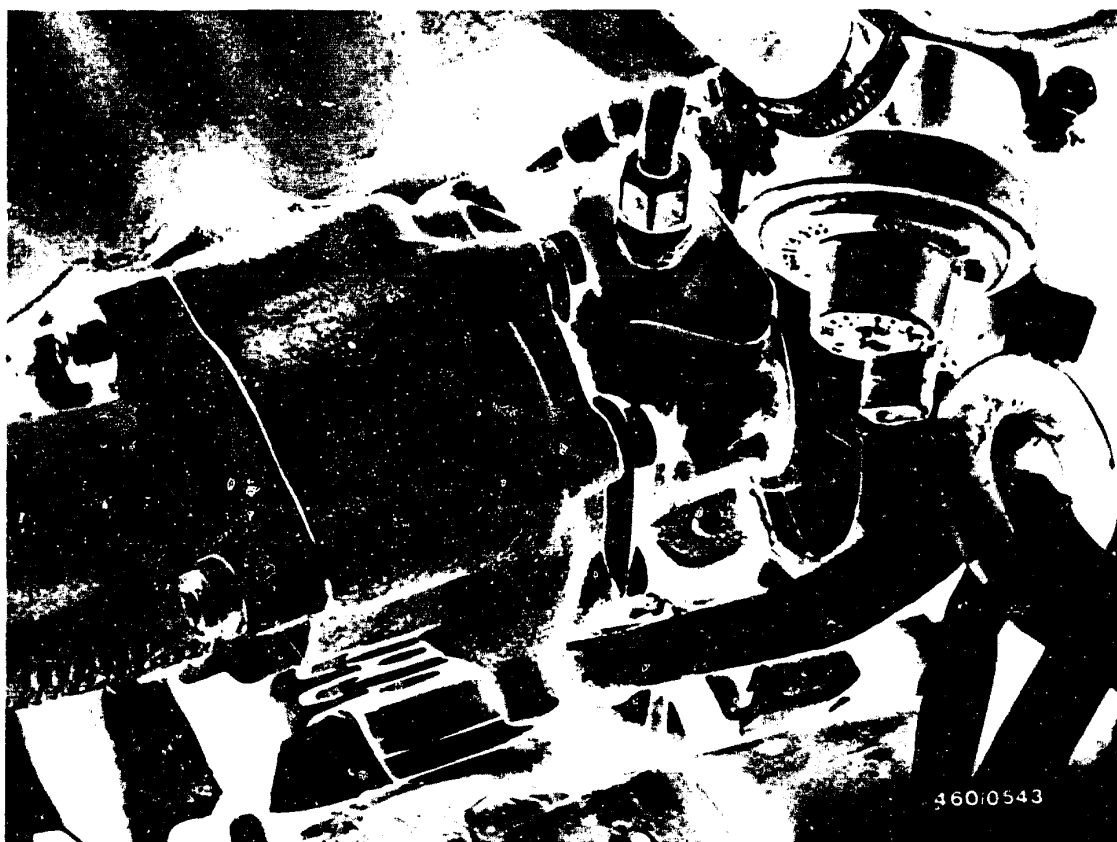
Replace vent screw with new gasket.

Screw down injection-pump support bracket.

Screw down injection lines on injection-pump delivery-valve holders and on nozzle holders.

Mount toothed-belt cover.





29. Checking charging-air pressure

When working on the turbocharger, keep in mind that it can be ruined by even the smallest particles of dirt!

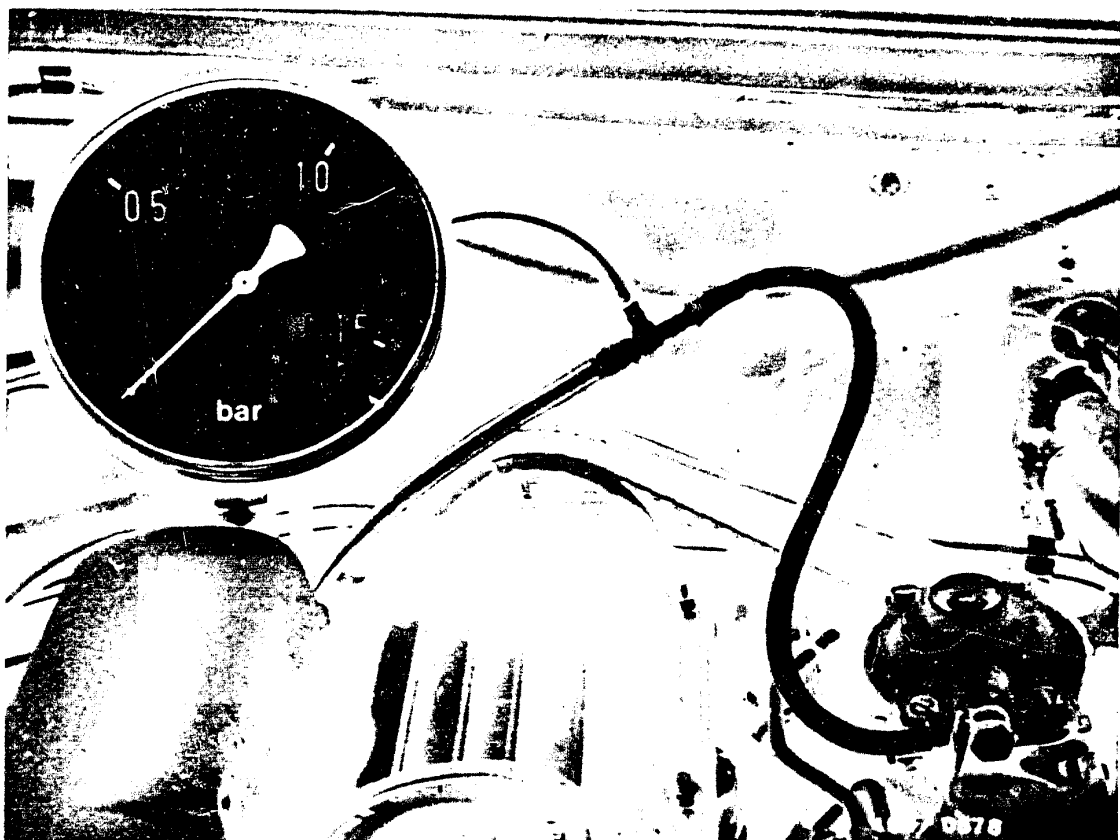
For this reason, n e v e r run the engine without the air filter.

Note:

The hose connected to the charging-air pressure control valve must not be removed.

Removal of the hose can cause overcharging, which can ruin the engine at full load.



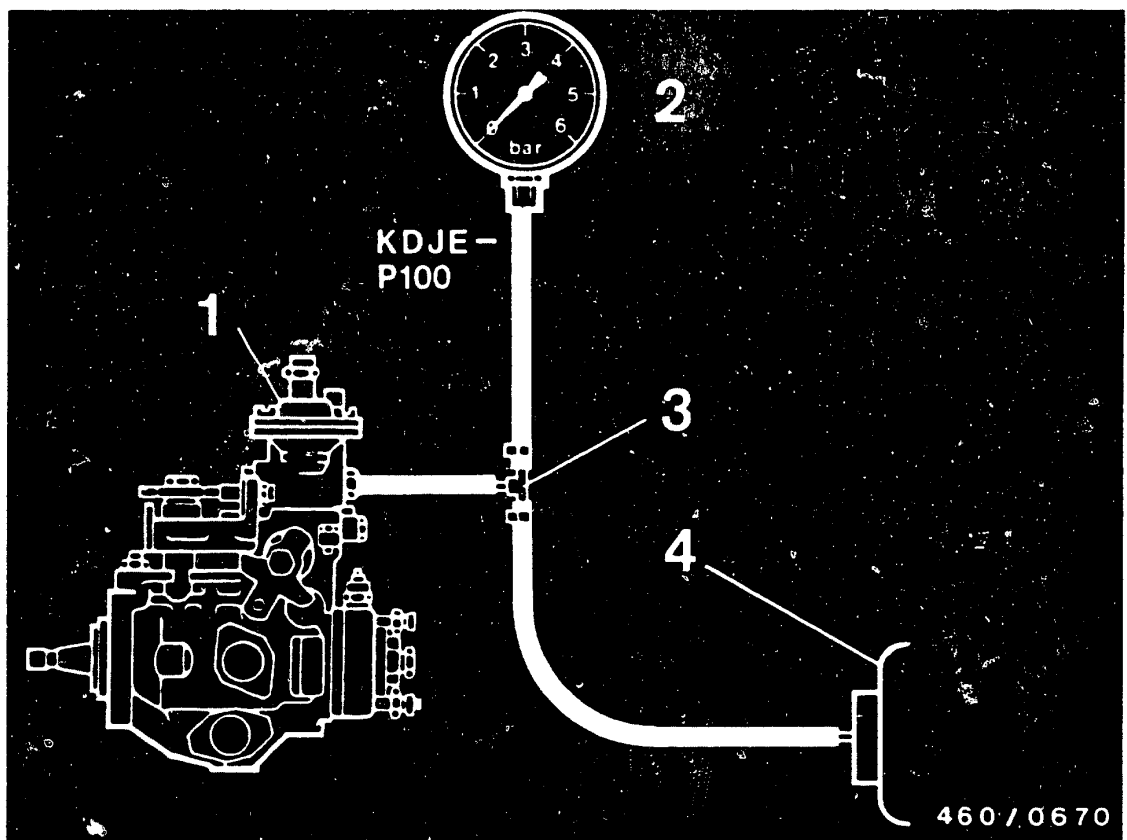


To test the charge-air pressure, it is possible to use pressure tester KDJE-P 100, or a pressure gauge 0...1.6 bar (e.g. Wika No. 4184) (picture).

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Check charge-air pressure
VW-Transporter





- 1 = Manifold-pressure compensator
- 2 = Pressure tester
- 3 = T-piece
- 4 = Charge-air pipe

Mounting pressure tester KDJE-P 100

Pull off one end of the connecting hose between charge-air pipe and injection-pump manifold-pressure compensator and connect to T-piece of pressure tester.

29.1 Measuring charging-air pressure

Charging-air pressure is measured at full load, either while driving or on chassis dynamometer.

Length of test per measurement max. 10 s

- On the chassis dynamometer:

In 3rd gear at 4000 min⁻¹

- While driving:

In 2nd gear by simultaneously braking the vehicle to approx. 30 km/h.

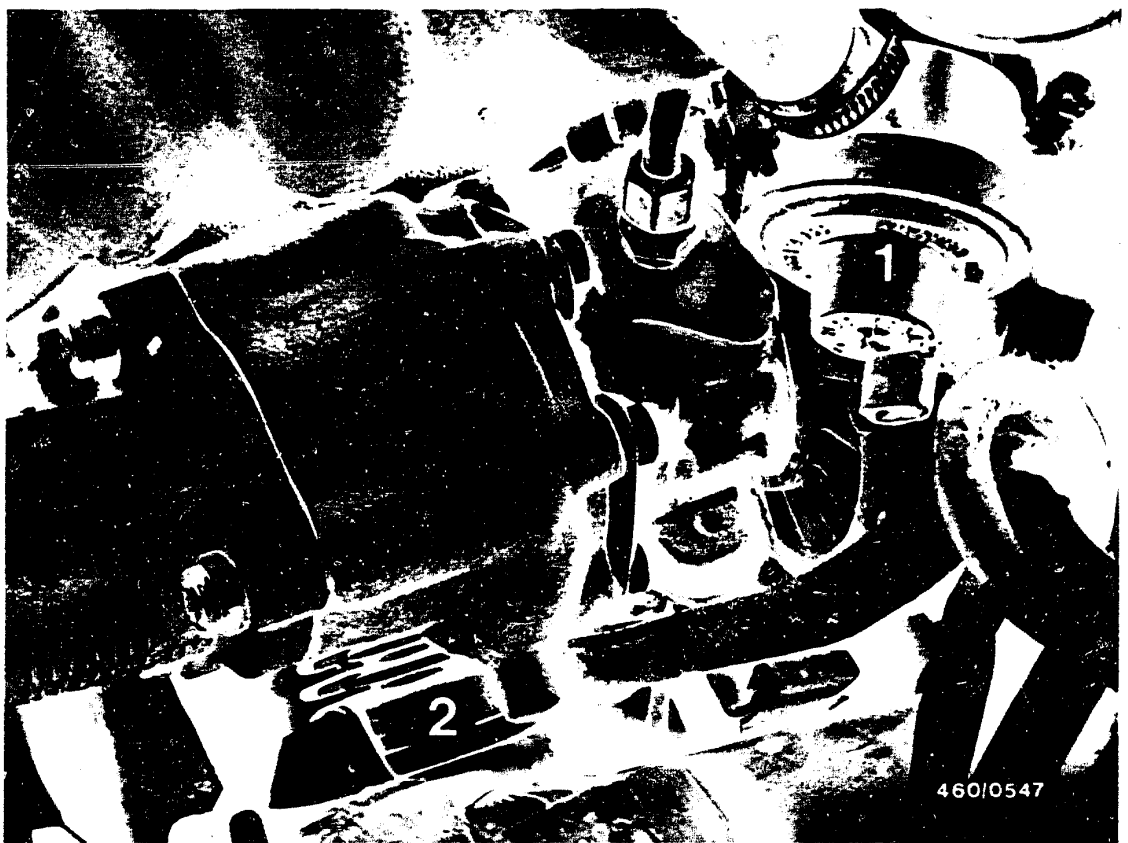
Read charging-air pressure at pressure gauge.

Set value: 0.64 ... 0.76 bar

Note:

For proper evaluation of turbochargers, the nominal start of pump delivery and the nozzle opening pressure must be correctly set, suction and exhaust connections must be tight, and the engine must be in good mechanical condition (valve play, compression).

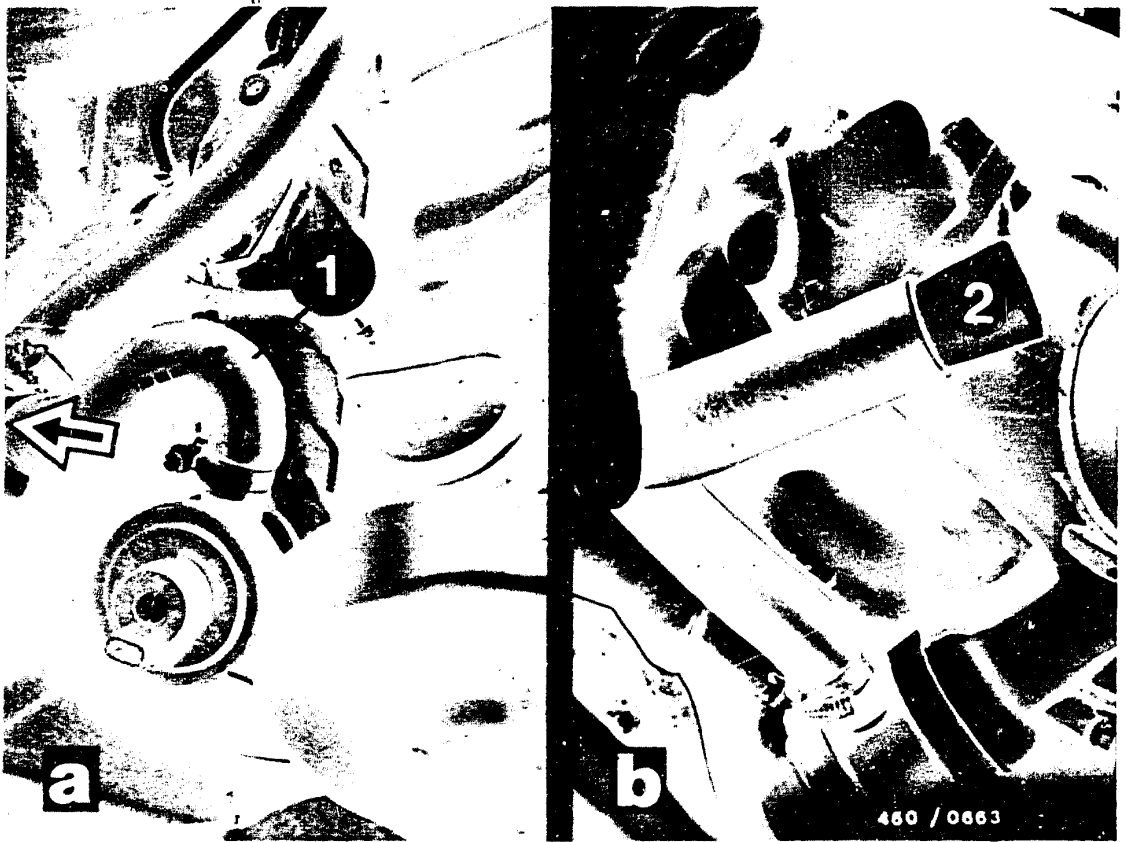




- 1 = Secondary-air valve
2 = Charging-air pressure control valve

Charging-air pressure too high

- Replace turbocharger.
(charging-air pressure control valve defective).



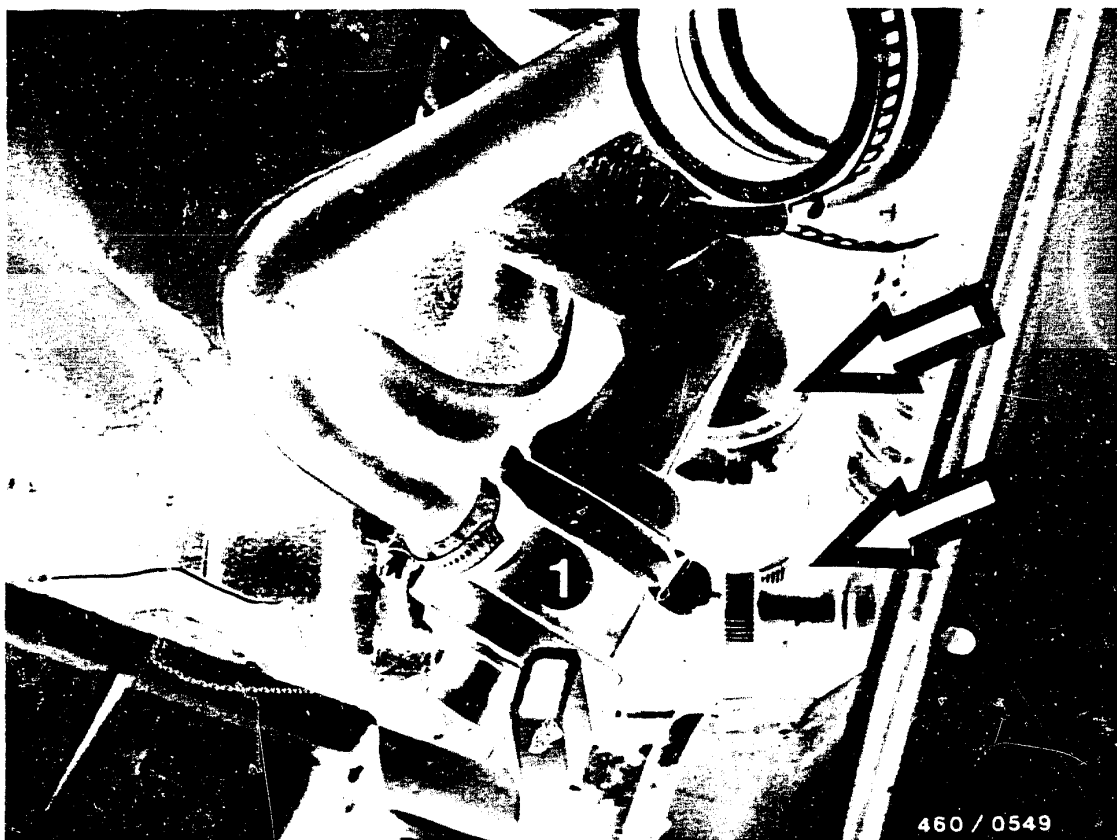
Charging-air pressure too low (secondary-air valve check)

- Remove hose from secondary-air valve (1) to air intake hose (arrow) and insert plug (2) (user-fabricated plug, 25 mm dia.). Tighten hose clamp.
- Repeat check of charging-air pressure.
- Set value for charging-air pressure: 0.64 - 0.76 bar
If set value is reached at this point, replace secondary-air valve.
- Charging-air pressure still too low
Turbocharger defective -- replace.

Caution!

After installation of new turbocharger, allow engine to run for approx. 1 minute to ensure proper supply of oil to turbocharger.





Checking turbocharger for tightness

If charging-air pressure is too low, check following points for leaks:

- Gasket between charging-air tube and engine block
- Hose connecting charging-air tube and manifold pressure compensator (injection pump)
- Leaks at secondary-air valve (1)
- Hose connecting distributor outlet and charging-air tube (arrows)
- Gasket between charging-air pressure control valve and turbocharger
- Gasket between exhaust manifold and engine block



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